Railway Mechanical Engineer

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Fuel Association Prize Competition

Over two thousand papers were received in the International Railway Fuel Association competition which closed August 31. This contest was inaugurated by Eugene McAuliffe, who offered a prize of $100 for the best paper on fuel economy by an engineman, fireman, brakeman, conductor or switchman, to be conducted by the Fuel Association. The result is ample proof that the work of this association, and others perhaps less directly, has borne fruit to the extent of at least creating a widespread interest in the subject. The number of papers is significant of the interest of the rank and file of the transportation employees. The wide support given by railroad officers in advertising the contest among their men and in many cases supplementing the association prize by one to be awarded to the writer of the best paper among their own employees, is evidence that executives and operating officers are also alive to the importance of the fuel problem. The award of the prize, delayed because of the tremendous volume of articles contributed, is awaited with great interest, but the real value of the competition will probably lie more in the consensus of opinions and suggestions offered by two thousand men from railroads all over America, than in the ideas developed in a few outstanding papers which may head the list.

A Big Machine Tool Program

In a survey of the progress of the railroads in the prosecution of their 1923 improvement projects, which was recently made by the publishers of the *Railway Mechanical Engineer*, it developed that twenty-six Class I railroads owning approximately one-third of the cars and locomotives in the United States, contemplated the purchase of approximately four million dollars' worth of machine tools during the last quarter of 1923. This, in effect, is the unexpended part of the 1923 budget for shop machinery and tools, but in itself it is considerably greater than the average annual expenditure for the same proportion of the equipment ownership of the country. The balanced character of the types of tools included in this program confirms what is indicated from other sources of information, that this program is to a large extent one of expansion of facilities rather than the renewal and improvement of the machine tool equipment in existing shops.

This program of expansion was begun during Railroad Administration control, and has been progressing steadily since that time. While some roads have practically completed their programs, there are still many others which have yet to undertake them, and the expansion phase of shop development undoubtedly will continue for several years. When it has been carried out to such an extent that the repair shop capacity of the country has become adequate to care for the amount and character of the equipment now operating on American railroads, its effect should be reflected not only in lower equipment maintenance costs, other things being equal, but in a material increase in the proportion of the serviceable equipment time.

But the possibilities for further improvements in the cost of equipment maintenance by the purchase of new machine tools will not have been exhausted by the completion of the expansion program. It is significant that many of the recent shop projects have not been the building of principal shops but the addition of purely repair shops at outlying points to take care of the overflow of equipment from the principal repair shops. It is at these central repair shops that a large part of the manufacturing operations required to furnish finished or semi-finished parts on store orders for the system are conducted.

The need for the replacement of much obsolete machine tool equipment in many of these old shops must still be met. Furthermore, with the rapid increase in the amount of equipment which has recently taken place and will continue to take place in the future, the opportunity for the extension of specialized manufacturing facilities is constantly becoming greater, so that the railroads undoubtedly will give an increasing amount of attention to the possibilities of what may be termed the production type of tool.

Bulletin the Good Ideas!

There are several incentives which will make a man work hard at his particular job and endeavor to give good service for the wages received, one of these being the necessity of earning a livelihood and another the hope of advancement. Still another powerful incentive, too infrequently provided in railroad service, is frank praise for a good job well done. Everyone knows how beneficial this incentive is to an ambitious man. It frequently changes his entire mental attitude toward the work in hand, causing him to study carefully all possible methods of improving his work, secure in the belief that this effort will be appreciated and result in his ultimate advancement.

While not a new suggestion, it might be a good idea in railroad shops and enginehouses to award prizes, or make some public recognition for the development of efficient tools, jigs and labor-saving methods by listing them on the bulletin board accompanied by the names of the man responsible. It is probably safe to say that every individual operation in a railroad shop requires a combination of manual and mental effort of which the latter is by far the more important. The time and labor involved in the operation can be greatly decreased by inducing the workman to think about his work and endeavor to develop some way of making it easier.

As an example of the prize award idea, one prominent railroad in the Middle West recently gave two prizes in the form of handsome brass tablets inscribed with the name of the repair shops which showed the greatest improvement in operation during the year. These tablets are to be mounted in a conspicuous place in the respective shops. Whether

prizes are offered and good suggestions bulletined or not, supervisory officers should constantly bear in mind that an important part of their duties is to recognize and give credit for initiative, industry and good workmanship on the part of their men, as well as to correct mistakes.

Tire Steel for Dies?

Freight locomotives cannot give as effective service hauling express trains as when coupled to tonnage freight trains, and it ought to be self evident that steel designed to be used in driving wheel tires cannot give its best service when made into dies and other tools for which it was not intended. That this practice is sometimes followed, however, was brought out during the Tool Foreman's convention, held in Chicago as reported in recent issues of the *Railway Mechanical Engineer*. One of the members asked, "What heat treatment can be given to scrap tire steel for dies to make it stand up? These dies are used only in stamping light gages." The answer is that scrap tire steel cannot be treated in any way that will make it entirely safe and suitable for use in dies.

In the first place it is not *safe* to use scrap tire steel in making dies because of its uncertain composition and the fact that no two worn tires will be found in just the same condition as regards hard and soft spots developed in service. One of the tool foremen summed the matter up in the statement that tire steel is as uncertain and variable in quality as the weather. Dies made of this material are liable to break with resultant danger to operators, damage to machinery and loss of labor in making the dies. Moreover it is not *economical* to use scrap tire steel in making dies because the low carbon content prevents efficient service. The carbon content of tire steel varies from about 50 to 70 points, depending on whether the tires are used in passenger, freight or switching service, and this is not high enough for a satisfactory die steel. A die is in reality a cutting tool and must be capable of holding a sharp cutting edge, particularly when used in stamping light material. The thinner the material, the harder it is to keep dies sharp and a higher carbon content, of about 70 to 85 points is needed for such tools.

Due credit should be given for all attempts to save, particularly in the use of material, in railroad shops, but it is false economy to try to substitute for a good grade die steel another steel which is both dangerous to use and frequently proves unsatisfactory after the expense of making it into dies has been incurred. Scrap tire steel is suitable for many purposes, such as lathe centers, shaper chuck screws and certain hot punches, but will hardly show good results when used for ordinary dies.

Future of Spray Painting—A Competition

The application of paint by spraying with air has been the subject of more or less discussion, and has been practiced to a limited extent for not less than twenty years. At the outset, the process appeared to offer big possibilities for increasing the labor output and decreasing the cost of equipment painting. It was pointed out that the process would greatly reduce the difficulty of applying paint to irregular surfaces of such a nature that access with the brush was extremely difficult, and that it also might be expected to increase the speed of covering flat surfaces in competition with the brush. During the intervening years, however, the extension of the process has been extremely slow. One of the greatest difficulties encountered in the early development of the spray process was the mist with which the atmosphere surrounding the job was filled, causing a considerable waste of paint and creating extremely unpleasant conditions for the operator, which were also dangerous when poisonous materials were being handled. This, no doubt, has led to some opposition to the adoption of the process on the part of many equipment painters as well as on the part of other men who work on or about equipment where the spray is in operation, especially when the work is being done inside the shop buildings.

Two facts were suggested by the discussion of this subject at the recent convention of the Equipment Painting Section of the Mechanical Division, American Railway Association. First, it is evident that since the early trials of the process, great improvements have been made in paint spraying apparatus as well as in the methods of employing it. Second, while many railroads are using the process to a limited extent, few have availed themselves of the full possibilities it apparently offers for the reduction of labor costs by making its use extensive.

What are the conditions that continue to limit the more extensive employment of the process? Do they lie in the attitude of the men, or in the economical handling of the paint material? Under what conditions can a successful practice be developed for the general application of the process in freight car painting? The process has been applied successfully to the finishing of passenger cars. Is this generally practicable? If not, what are the conditions which make it impracticable? Are its present limitations inherent, or can they be overcome?

Because we believe that a thorough discussion of this subject will be of great benefit not only to the readers of the *Railway Mechanical Engineer* but to the railroads as a whole, we offer a first prize of $50 and a second prize of $35 for the two papers received at our office of publication, 30 Church street, New York, on or before January 1, 1924, which most constructively answer any or all of these questions. Give the industry the benefit of your experience on this important subject.

Putting Repairs on a Manufacturing Basis

In the fourth article on Locomotive Scheduling at the Silvis Shops, which appeared in last month's issue, the authors ventured to point out the possibilities for increased output which would follow if the processes of locomotive repairs could be distinctly separated into the manufacturing operations, which would include the manufacture of new parts and the repairing of old parts, and the stripping and erecting operations. In its extreme application, this would require a complete stock of repair parts available for each class of locomotives entering the shop, which could be drawn on immediately by the erecting shop, with the manufacturing department proceeding to repair the old parts, or replace them with new parts, to be restored to stock. On another page in this issue will be found an article which shows clearly not only the practicability, but the desirability of this separation with respect to one group of parts—locomotive brake equipment—as it has been worked out on the Canadian National. The article points out that the practice, installed originally in order that the standards of maintenance might be better controlled by having all repairs confined to a few well equipped shops, has expedited the return to service of locomotives from which defective parts are removed. Furthermore, it has been the means of developing a simple system of finding comparative unit repair costs, that almost automatically has led to a marked reduction in these costs. A study of this article will suggest to the reader that the reason that the cost data have been developed with apparently so little additional clerical work is because the work has been removed from the category of locomotive repairs to the field of store orders. A

system of standard store order numbers, each covering a single piece of apparatus or part, readily provides for developing unit costs in as much detail as may be desired.

The results obtained within the limited scope of locomotive brake repairs are sufficient to demonstrate the correctness of the principle involved in the suggestion for the complete segregation of repair operations from the operations of stripping and reassembling the locomotive ready for service. It would probably be impracticable under any conditions likely to be found on American railroads ever completely to develop such a system. There are probably few railroads, however, owning, say, 500 or more locomotives on which a partial application of the idea does not offer an opportunity for reducing idle locomotive time and effecting reductions in shop costs. Costs will be reduced, first, because a better balance of the operations in the repair department can be maintained, irrespective of the conditions in the erecting shop, and second, because a better control can be exercised over the unit costs of repaired detail parts through the medium of the store order system.

The limitations on the extension of such a system will depend on many local conditions, principal among which will probably be the number of locomotives per class and the extent to which details have been standardized between locomotives of more than one class. If, for instance, the valve motion has been made interchangeable on several classes of locomotives, the extent to which production methods can be employed in the manufacture of these parts may make it cheaper to scrap some of the parts, particularly pins and bushings, and renew them from stock, than to refit the worn parts. This not only means cheaper repairs but less time for the locomotive awaiting the application of repaired parts, particularly in the engine terminal. The possibilities for reducing the amount of repair work chargeable directly to the locomotive by the use of semi-finished parts, such as crank pins, knuckle pins, frame bolts, etc., have been set forth in numerous articles in these columns. But in cases where the number of locomotives in a class is large, are there not also possibilities for the extension of this scheme to include the side and main rods, crossheads, guides and pistons? The extension of this practice will inevitably tend toward more systematic procedure in the repair operations, and the facts about costs readily made available under the store order system will provide much better than the usual basis for the exercise of sound judgment by the supervision.

Turbo-Condensing Locomotives

The thermal efficiency of the ordinary type of steam locomotive is unquestionably much lower than would be tolerated in a stationary or marine power plant of the same capacity. While the railroad motive power man may look with envy at the low fuel and water rates of the large modern electric power plant, the power plant engineer, when he examines the modern locomotive invariably is impressed with the large horsepower which it is capable of developing per unit of weight or per cubic foot of space occupied. In cost, weight or space per unit of power developed, the locomotive is surprisingly different from other power plants. Moreover, it must carry its own supply of fuel and water. Increasing operating costs are accentuating the demand for increased efficiency of the locomotive and considerable attention is being given to investigations of the possibilities of the substitution of the turbine for the reciprocating steam engine. The success of any turbine driven locomotive will depend largely upon the solution of the two difficult problems of transmitting the energy developed by the turbine to the driving wheels and thus producing drawbar pull and of designing an efficient, compact and light weight condenser.

Three methods of transmission have been developed to a stage where they offer possibilities: Namely, reduction gearing, electric generator and motor and hydraulic. In the locomotives described in this issue the electric method has been adopted. The necessary generator, motors and control apparatus add to the weight, complication of equipment, cost and space occupied, but give a reliable and flexible speed control with large starting power. The complete Ramsay locomotive of 1,100 motor horsepower and 22,000 lb. tractive force weighs at the rate of 266 lb. per motor horsepower and 13.3 lb. per pound of tractive force. A light Pacific type locomotive, such as is frequently used on American roads, is of about 2,250 hp. and 40,000 lb. tractive force. In working order, including tender, the weight is about 210 lb. per cylinder horsepower, and 11.5 per pound of rated tractive force.

The problem of a compact and efficient condenser has been worked out for the Ramsay locomotive in a highly interesting way by rotating the nest of tubes filled with exhaust steam so that after dipping into a trough of cooling water they are subjected to an air blast from a motor-driven fan. This method is distinctly different from that employed for other turbine locomotives. On one of these the stationary tubes are sprayed with water and subjected to currents of air set up by the movement of the locomotive. On another design, thin flattened copper tubes are employed, these being cooled solely by currents of air produced by a fan. The efficiency of a turbine is dependent upon a high vacuum, and this means an effective condenser. If the condenser is to be of light weight as well as efficient, the rate of condensation must be quite rapid, and to be a success for locomotive service must produce the required vacuum at all temperatures under which the locomotive is to be operated. Considerably more data than is yet available must be collected before the relative effectiveness of the condenser designs thus far worked out can be determined or whether any of them will meet the difficult requirement demanded for successful locomotive operation.

New Books

A FIRST COURSE IN MACHINE CONSTRUCTION AND DRAWING. *By T. N. Naylor and W. Tattersall.* 158 *pages,* 5½ *in. by* 8½ *in. illustrated. Bound in cloth. Published by H. F. & G. Witherby,* 326 *High Holborn, London, W. C.* 1.

This volume is particularly adapted for use as a text book by the student of drawing who approaches the subject with no previous knowledge of engineering. It takes up first the simplest details, such as rivets, riveted joints, and screw threads, then progressing through the various types of machine details to the more complicated assemblies of parts. For each detail or assembly, typical sketches are arranged on the left-hand page, facing the descriptive text which briefly outlines types, uses, safe loads, etc. The book, therefore, not only provides plates to guide the student in his practice, but conveys a considerable degree of elementary information concerning most of the simple types of details and materials met with in machine construction.

PROCEEDINGS OF THE INTERNATIONAL RAILWAY FUEL ASSOCIATION, 1923. *Edited by the secretary, J. B. Hutchison,* 6,000 *Michigan Avenue, Chicago,* 389 *pages,* 6 *in. by* 9 *in. Flexible binding.*

This volume contains the proceedings of the fifteenth annual convention of the International Railway Fuel Association, which was held at Cleveland, Ohio, May 21 to 24, inclusive, 1923. It contains the reports of committees and discussions on the following subjects: Boiler Feedwater Treatment; Fuel Stations; Locomotive Front Ends, Grates and Ashpans; Fuel

Accounting, Distribution and Statistics; Firing Practice, and Coal Storage. It also contains individual papers on the following subjects: Railway Fuel—A Reducible 13 Per Cent of Operating Expenses, by Julius Kruttschnitt; The Relation of the Coal Mines to the Railroads; Extension of Long Locomotive Runs; The Fuel Saving Aspect of Boiler Water Treatment; Lake Coal Handling; Classification of Coal; Economic Aspects of the Fuel Oil Situation; Value of Individual Fuel Performance Records; Incentives for Promoting Fuel Economy; The Superheater—Its Use and Abuse as a Fuel Saver; Economy in the Heating of Stations and Buildings; The Other Ten Per cent; Locomotive Oil Burning Refractories.

WELDING CYCLOPEDIA. *Edited by L. B. McKenzie and H. S. Card. 438 pages, illustrated, 6 in. by. 9 in. Bound in flexible imitation leather. Published by The Welding Engineer Publishing Co., Chicago.*

This is the third and enlarged edition of a reference book on the theory, practice and application of autogenous welding processes. The first half of the book consists of a dictionary of the terms used in the industry, together with instructions for welding operations of the usual type. Succeeding chapters treat of electric arc welding, electric resistance welding, oxyacetylene welding and thermit welding in detail. A further section covers the rules and regulations of federal and state authorities and insurance companies. Various charts and tables are included, and at the end of the book is a comprehensize catalogue of welding apparatus and equipment. In this edition information has been added on the training of operators and considerable new material relative to special welding jobs—including tanks, pipes and plate work—has been included.

What Our Readers Think

Babbitting Crossheads

ATLANTA, Ga.

TO THE EDITOR:

We are experiencing some difficulty due to the failure of the babbitt to adhere to the crossheads. Would like to know how this work should be performed and whether steel crossheads should be tinned before babbitting.

HENRY J. ARMSTRONG

(A method which is being used with success in the shops of one large road is as follows: After being set up on the babbitting table, the old babbitt is melted off the crosshead with a burner. This pre-heats the crosshead to about the proper temperature for pouring the new babbitt lining. When the old babbitt has been melted off, the crosshead is well brushed with a steel wire brush and thoroughly cleaned with sal-ammoniac. The surfaces are then tinned, after which the forming blocks are set up and the babbitt poured. It is reported that after the men become familiar with the work, they rarely fail to obtain a good job of babbitting and that but little trouble is experienced with babbitt becoming loose or falling off.

The fixtures and methods in use on the D. L. & W. for babbitting crosshead shoes are described on page 772 of this issue. It will be noted that on this road the forming blocks are made to such a size that the babbitt is never machined after it has been poured. The surfaces as poured against the blocks are harder, and it has been found that the babbitt wears considerably longer than when it is machined before the crossheads are placed in service.—EDITOR.)

Adjusting Safety Valves

MINNEAPOLIS, Minn.

TO THE EDITOR:

When adjusting the safety valves on a locomotive, which valve should be set first—the plain valve or the one with a muffler? Would like to know what is the general practice on different roads and the reasons for such practice.

OSBORN WILLIAMS

(The following procedure is the one which has been satisfactorily followed for some time on several large eastern roads: The open pop valve, which is adjusted at a slightly higher pressure than the one with a muffler, is always set first. The lower pressure muffled one is then adjusted. The men performing this work have been educated in regard to the proper blow-down of safety valves and to adjust them so as to obtain a blow-down of from 3-lb. to 4-lb., which gives the maximum lift to the valve. With a 2-lb. to a 3-lb. blow-down, a full valve opening is not obtained. It has also been found from experience that the valve seats cut much more rapidly by the severe wiredrawing of the steam when the opening is small.—EDITOR.)

How Should Driving Box Wedges Be Adjusted?

CHICAGO, Ill.

TO THE EDITOR:—

Am anxious to know what adjustment of the driving box wedges on Pacific type locomotives will give the best results in operation. The locomotives referred to are engaged in heavy and fast passenger service, making a run of 115 miles in about three hours, twice a day. They weigh 190,000 lb. on the drivers, have 11½ in. by 21 in. main journals and 11 in. by 14 in. front and back journals. The driving boxes are of cast steel, brass lined and packed with grease. Shoes and wedges also are of cast steel.

There is a considerable diversity of opinion among the roundhouse men who adjust the wedges as to how the work should be done. One man will set up all wedges snug with a 10 in. wrench and then pull the main wedges down ⅛ in. to 3/16 in., and the front and back wedges down ¼ in. to 5/16 in. Another man will pull all wedges down ⅜ in. or more.

Complaints of rough and hard riding are frequently made by engineers. At other times the same engines are known to ride smoothly. Can you advise just how tight the wedges on such engines should be set to prevent hard riding and at the same time to give as little pound as possible in the boxes?

W. V. MAXWELL.

(This question is one which roundhouse men are frequently called upon to answer. In many cases where rough riding has been complained of, it also is probable that traveling engineers have ridden the engines after the wedges have been adjusted to give a definite amount of clearance. We would be pleased to receive and publish replies from our readers giving the practices which they have followed themselves, or know that others have followed with satisfactory results. While Mr. Maxwell refers specifically to a Pacific type locomotive in fast passenger service, those replying might, with advantage, take up the whole broad problem of wedge adjustment for all kinds of equipment.—EDITOR.)

Engineering Building—Montana State College

What Does a Successful Executive Require?

Is It a Knowledge of the Technique of the Business or an Understanding of Men?

First Prize in Special Apprentice Competition

By Dale C. Sheffield*
Special Apprentice, Chicago, Milwaukee & St. Paul, Bedford, Ind.

SINCE executives are beginning to realize more and more the value of an apprenticeship course for college graduates, they have endeavored to shape its schedule to provide a thorough training; one that will cover an appreciation of such things as the necessity for reducing turnover and stabilizing employment, give a better understanding of elementary economics as applied to the concern, and, above all, inculcate in the candidate a greater interest in, and loyalty to, the company. But since the direct supervision over this training is passed down the line, it is doubtful if the student is so influenced as to absorb the above points from those who have direct charge of him during the training period.

Most foremen are interested in the amount of work accomplished and, as a rule, will not go out of their way to see that the apprentice is properly instructed along lines to develop his loyalty and good faith towards the company. The railroads are still clinging to the old method of having the foreman "break in" all new men, and consequently the technical graduate is put through a course very similar to that of the regular apprentices. Part of the shop work is essential to the proper training of the apprentice, but that which is not should be eliminated from the course. It hardly seems reasonable that the apprentice should be compelled to repeat the training which he has already had under a competent instructor in his college. Yet such is the case. Take, for example, the training period to be spent in the blacksmith shop. The foreman in charge does not realize that the student has already had an extensive training in the heat

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treatment of metals, welding and general foundry work under instructors who have been especially trained to teach just these subjects. Such faults could be corrected by allowing a group of men who are familiar with the average engineering college curricula to check over and revise the schedule.

When a young man spends four of the best years of his life in college, learning the fundamentals of his profession, he becomes discouraged and restless when he has to repeat subjects, because he is in the habit of learning new things. If the management thinks it is advisable to repeat certain subjects, then it should select the proper man to act as an instructor in those subjects. Too frequently a man is chosen to teach just because he knows the subject. Very often the man who is not the expert is a better teacher, since he has the gift of teaching or has received special training in that art.

Put Real Problems Up to Special Apprentices

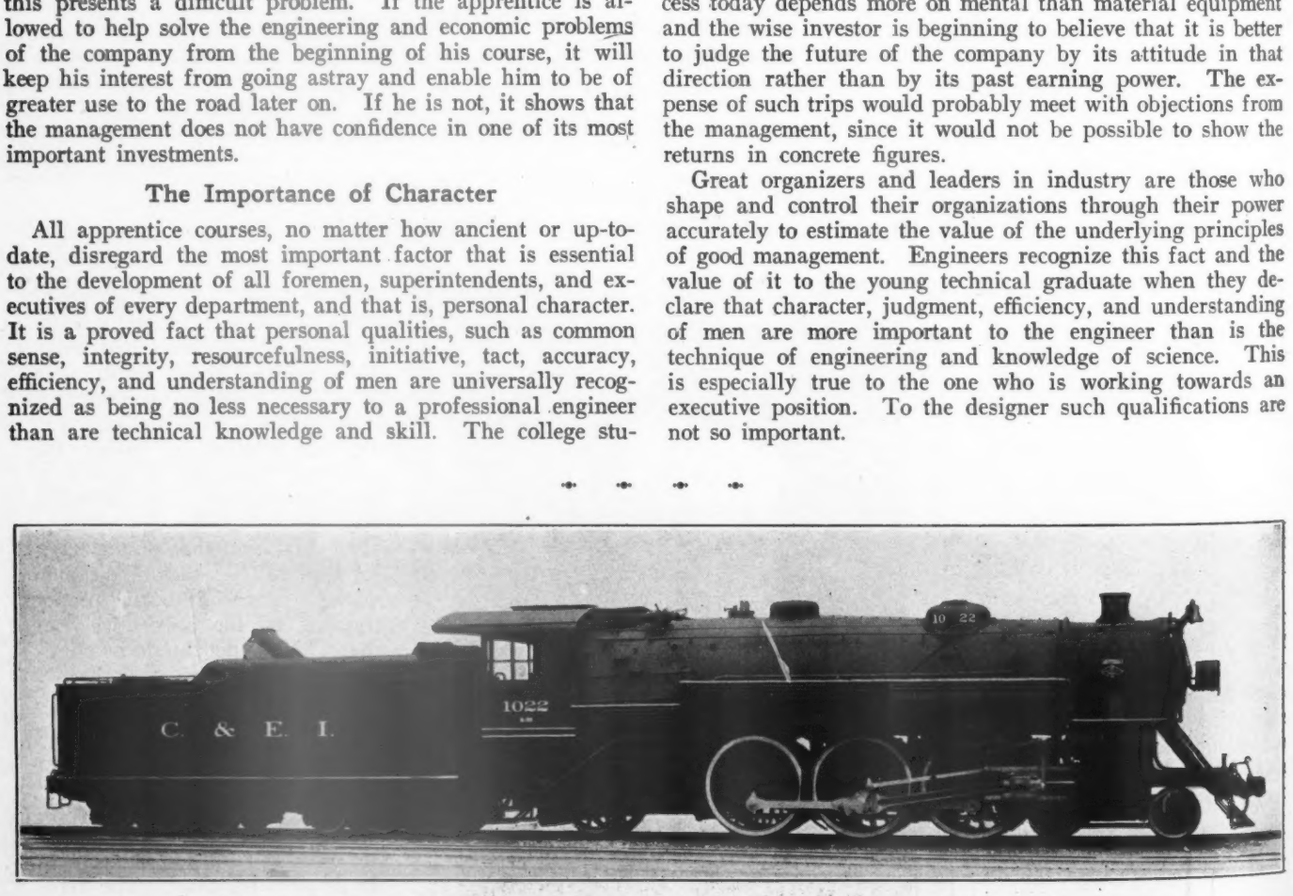
The greatest evil of the special apprenticeship course is the time element. Non-technical men do not realize the greatness of the engineering field, nor of the rapid development of every phase of the profession, and, above all, the important part science plays in the solution of engineering problems. When the apprentice is allowed to spend all his time in the shop his knowledge of thermodynamics, mechanics, and other such subjects—which are essential to the profession of an engineer—begins to slip away from him, for the lack of exercise; by the end of two years he will find that he is pretty rusty in those fundamentals which were so hard to get. The field is developing at such an ever-increasing ratio that the latest text books of four years ago are completely out-of-date, and to the college professor this presents a difficult problem. If the apprentice is allowed to help solve the engineering and economic problems of the company from the beginning of his course, it will keep his interest from going astray and enable him to be of greater use to the road later on. If he is not, it shows that the management does not have confidence in one of its most important investments.

The Importance of Character

All apprentice courses, no matter how ancient or up-to-date, disregard the most important factor that is essential to the development of all foremen, superintendents, and executives of every department, and that is, personal character. It is a proved fact that personal qualities, such as common sense, integrity, resourcefulness, initiative, tact, accuracy, efficiency, and understanding of men are universally recognized as being no less necessary to a professional engineer than are technical knowledge and skill. The college student of engineering regards literature and sociology as unnecessary chores, to be endured rather than enjoyed; this is due to the tendency to magnify the importance of technique or problems of research and natural science. All through college, one's standing is based on correct answers, which naturally minimizes the importance of personality. The greatness of the personal character element was shown by the reply which was received to the letter sent to 30,000 members of four large engineering societies, who were asked to number six groups of qualities headed: character, judgment, understanding of men, technique, knowledge, and efficiency, in order of importance. A summary of the replies to the request showed that character was placed at the head of the list by a vote of 94.5 per cent, while technique was voted to the bottom of the list by an equally decisive majority.

This indicates that to the man who would deal successfully with human labor and with business, personality is a greater asset than technical knowledge and skill. About 90 per cent of the so-called political-pull is really a promotion based on personality. The college graduate has the foundation of knowledge of technique, but as a rule his personal character is badly in need of development. The best possible way to grasp the secret is by the close association with men who have battled their way, without the aid of a college education, from the bottom to positions which require executive ability. To develop this requirement, the apprentice should be allowed to go occasionally on trips of inspection with master mechanics and superintendents, where he can learn from observation and conversation. At the same time he will be storing away valuable information that will be very useful to him when he attains the executive position for which he is being trained. Success today depends more on mental than material equipment and the wise investor is beginning to believe that it is better to judge the future of the company by its attitude in that direction rather than by its past earning power. The expense of such trips would probably meet with objections from the management, since it would not be possible to show the returns in concrete figures.

Great organizers and leaders in industry are those who shape and control their organizations through their power accurately to estimate the value of the underlying principles of good management. Engineers recognize this fact and the value of it to the young technical graduate when they declare that character, judgment, efficiency, and understanding of men are more important to the engineer than is the technique of engineering and knowledge of science. This is especially true to the one who is working towards an executive position. To the designer such qualifications are not so important.



Pacific Type Locomotive Built by the Lima Locomotive Works for the Chicago and Eastern Illinois

The design is similar to the U. S. R. A. heavy 4-6-2 type, but is equipped with a tender carried on six-wheel trucks and a special coal pusher.

Lehigh Valley Class N-5-B Mikado Locomotive Built by American Locomotive Company

Mikado Locomotives for the Lehigh Valley

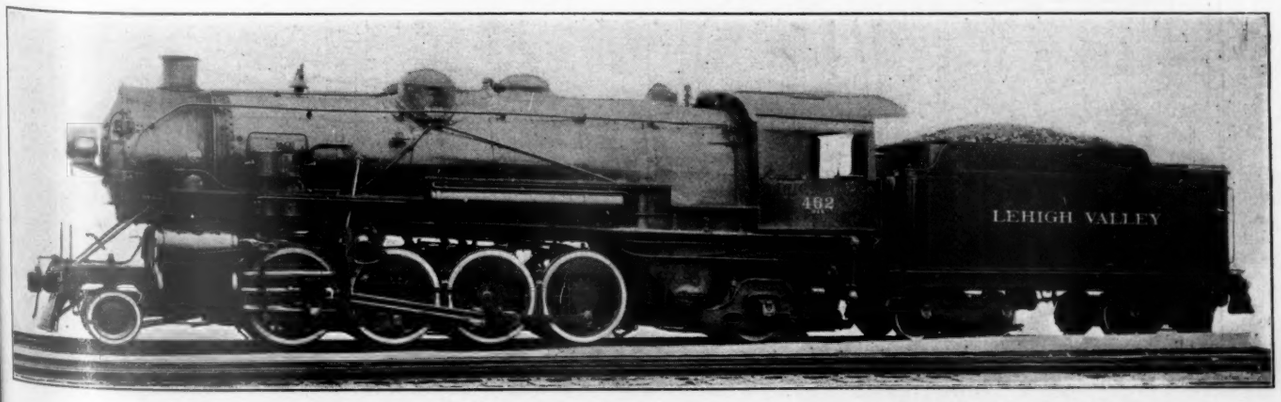
Heavy Freight Engines for Anthracite Road Burn Soft Coal—Booster Increases Tonnage Capacity

THE Lehigh Valley has recently increased its freight handling capacity by the addition of 30 heavy Mikado type locomotives. The order for this new power was divided equally between the Baldwin Locomotive Works and the American Locomotive Company, each builder furnishing 10 locomotives without a booster and five with a booster. Although similar in weight and in general proportions, there are, however, a number of differences in the designs as worked out by the two builders.

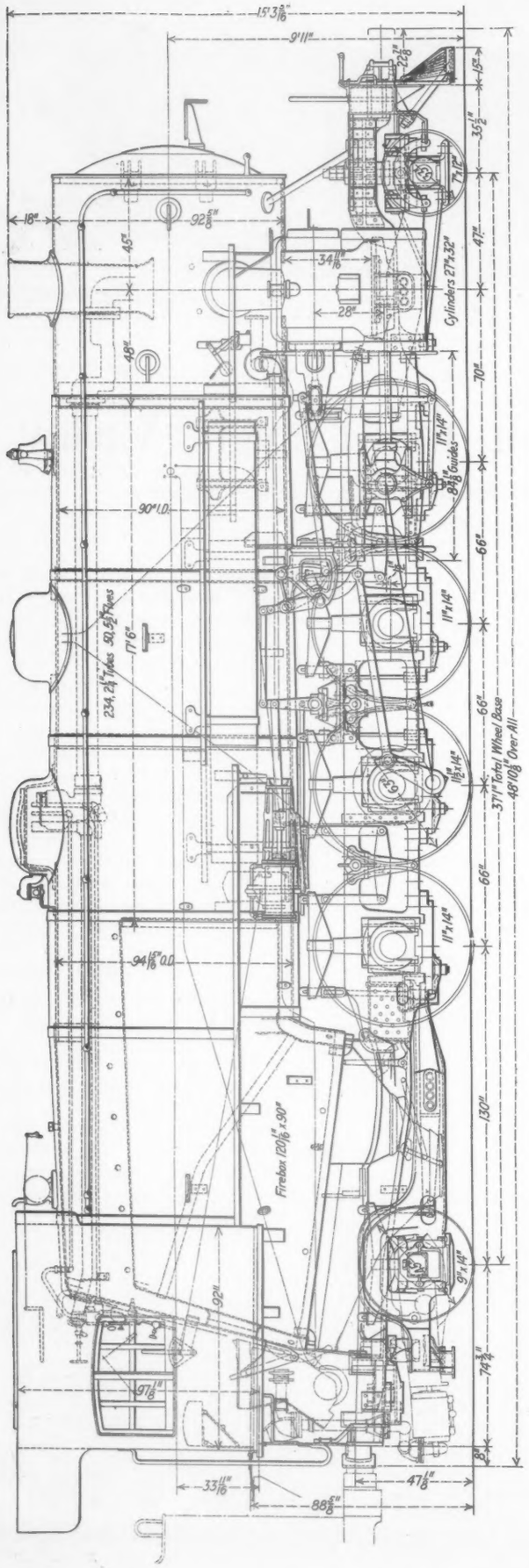
Locomotives of the 2-8-2 type were first used on the Lehigh Valley about 11 years ago, and the number has been steadily increased as additional power has been purchased from time to time. In the past, the 2-8-2 type locomotives on this road have been fitted with wide fireboxes having a large grate area suitable for burning a mixture of anthracite and bituminous coal. The Mikado locomotives recently received are the first ones of this type on the Lehigh Valley which are fitted with medium wide fireboxes and a grate designed for burning soft coal. In this connection, a comparison between the locomotives built by the Baldwin Locomotive works in 1921, known on the road as Class N-3-A, and those furnished by the same builder in 1923, which are known as Class N-4-B, is of interest. Both designs had 27-in. by 30-in. cylinders, 63-in. driving wheels and were of approximately the same weight. The older engines carried 190 lb. steam pressure and had a rated tractive force of 56,100 lb. An increase in steam pressure to 200 lb. raised the tractive force on the 1923 engines to 59,000 lb., exclusive of the booster. The fireboxes on the 1921 locomotives were of the Wootten type, 114⅛ in. wide by 126 1/16 in. long inside, which gave a grate area of 100 sq. ft. and a heating surface of 264 sq. ft. in the firebox and 84 sq. ft. in the combustion chamber. In the new soft-coal burning locomotives, the fireboxes are 90 in. wide by 120 1/16 in. long, which gives a grate area of 75 sq. ft. and a heating surface of 224 sq. ft. in the firebox and 112 sq. ft. in the combustion chamber. Both have the same number of tubes and flues, all of them being 17 ft. 6 in. long.

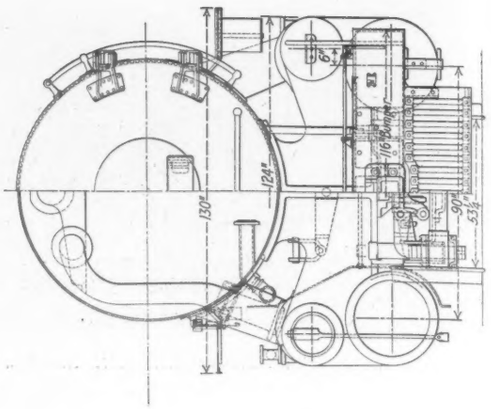
The boilers used on the Mikado type locomotives built by the Baldwin Locomotive Works in 1923 were practically the same as those designed for the Lehigh Valley locomotives of the Pacific type, Class K-5, the first of which were built in 1916. These locomotives are used in fast freight and heavy passenger train service and burn soft coal. The standardization of locomotive boilers and the use of one design for more than a single type of engine, where such use is possible and the details have been well worked out, simplifies the maintenance and reduces the cost. Standardization of mechanical parts is frequently, if not usually, given careful attention, but standardization and interchangeability of boilers have often received far less consideration than their importance warrants.

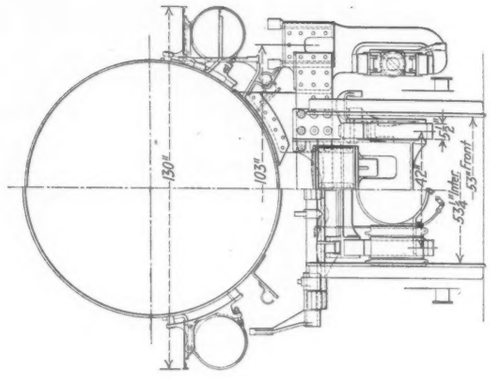
The new Baldwin Mikado locomotives with boosters weigh 325,200 lb. in working order, of which 237,900 lb. is on the drivers. The cylinders are 27 in. diameter by 30 in. stroke. The rated tractive force of the locomotive alone is 59,000 lb. with 11,000 lb. additional for the booster. The boilers are of the wagon-top type, 82 in. diameter inside the first ring, and have a combustion chamber 48 in. long. There are 254

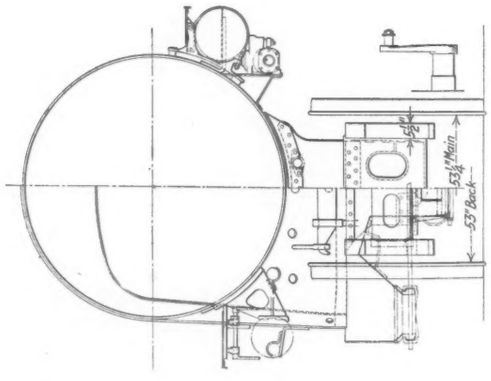


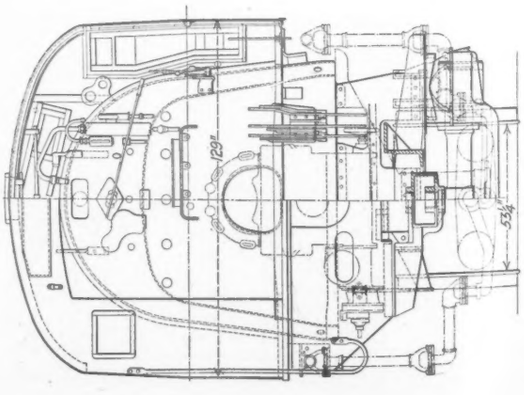
Lehigh Valley Class N-4-B Mikado Locomotive Built by Baldwin Locomotive Works



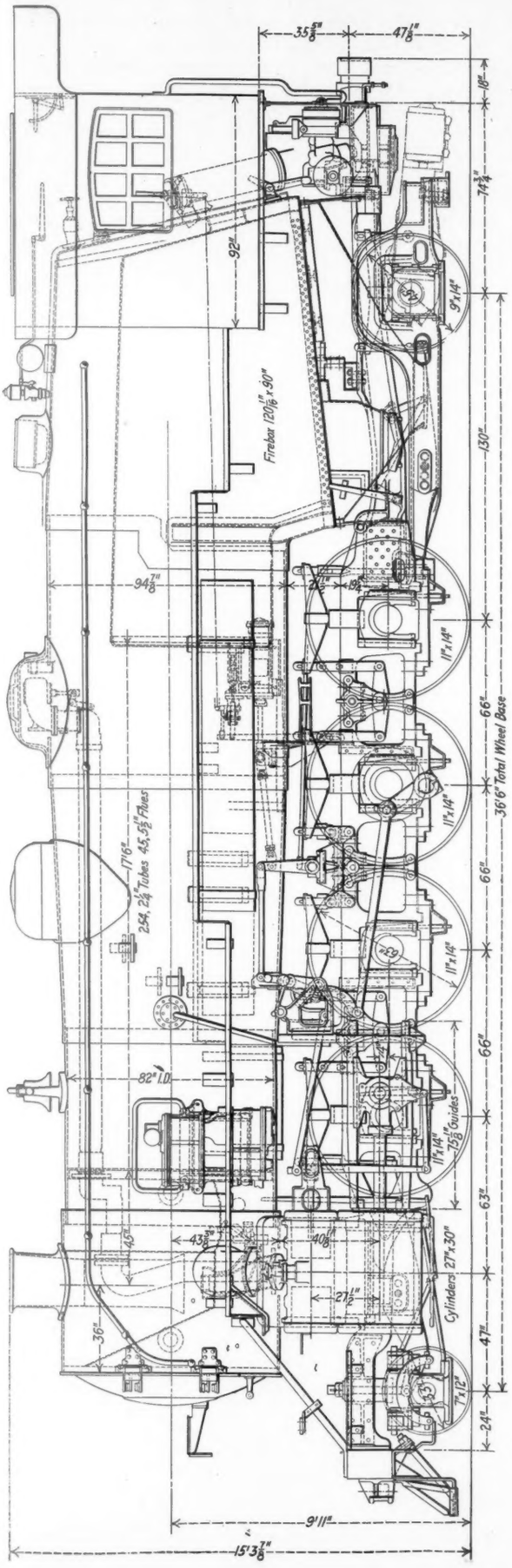


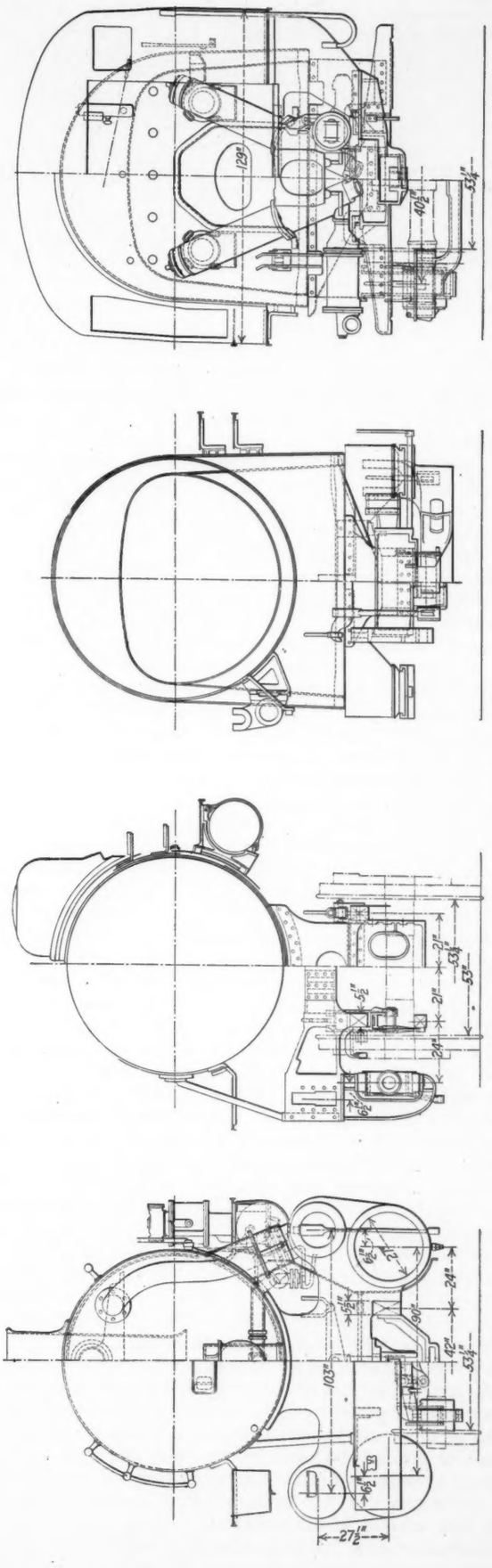






Mikado Type Locomotive Built by the American Locomotive Company for the Lehigh Valley





Mikado Type Locomotive Built by the Baldwin Locomotive Works for the Lehigh Valley

Mikado Type Locomotive Built by the American Locomotive Company for the Lehigh Valley

tubes, 2¼ in. diameter, and 45 flues, 5½ in. diameter. The total evaporative heating surface is 4,110 sq. ft. and the superheating surface is 980 sq. ft. According to Cole's ratios, the boiler horsepower is 2,770 and the cylinder horsepower 2,624. The estimated coal rate is 113 lb. per sq. ft. of grate per hour. These proportions should give a boiler which will furnish ample steam without heavy forcing.

The Mikado locomotive, with booster, built by the American Locomotive Company, weighs 325,000 lb. in working order, of which 239,000 lb. is on the drivers. The cylinders are 27 in. diameter by 32 in. stroke. The rated tractive force of the locomotive alone is 63,000 lb. and 74,000 lb. with the booster added. The boilers are of the straight-top type, 90 in. in diameter inside the first ring, and have a combustion chamber 46 in. long. Of the staybolts, 650 are of the flexible type. There are 234 tubes, 2¼ in. diameter and 50 flues, 5½ in. diameter. The total evaporative heating surface is 4,009 sq. ft. and the superheating surface is 1,074 sq. ft. The rated boiler horsepower is 2,760 and the cylinder horsepower 2,624. The estimated coal rate is 113 lb. per sq. ft. of grate per hour. Tubes and flues are welded to the back flue sheet. In comparison with the Baldwin locomotive, it will be noted that the stroke of the cylinders is 2 in. longer, which somewhat increases the tractive force. The boiler is 8 in. larger in diameter, the superheating surface is larger and the number of tubes somewhat less.

The Lehigh Valley locomotives are counterbalanced in accordance with the Master Mechanics' standards, and particular attention is given to keeping the weight of the reciprocating parts as light as consistent with the required strength. The piston rods, main and side rods, crank pins and axles are of open-hearth steel. On the American locomotives the piston and rod weigh 801 lb., the cross head 607 lb., the combination link 35 lb. and the front end of the main rod 404 lb. On the Baldwin locomotives the piston and rod weigh 752 lb., the crosshead 601 lb. and the main rod, total, 1,065 lb.

The Baker valve gear operates piston valves of 14 in. diameter and a maximum travel of 6 in. A power reverse gear is provided, Alco Type E being used on the American locomotives and the Ragonnet on the Baldwin locomotives. All of these locomotives are fitted with stokers, those on the Baldwin engines being of the Duplex type and those on the American engines being of the Elvin type.

The following are among the other specialties used: Type A superheaters, Delta trailing trucks, Commonwealth frame cradles, Unit drawbars and radial buffers, Franklin adjustable wedges, Smith adjustable hub liners, Chambers throttle valves on American engines and railroad standard balanced type on Baldwin engines, Talmadge drifting valves, Detroit lubricators, Hancock injectors, Nathan water columns, Vissering sanders, Pyle-National headlights, Butterfly fire doors, Okadee smokebox hinges, Hunt-Spiller cylinder and valve bushings, also piston and valve rings, King piston and valve steam packing, one 8½ in. cross compound air compressor and Beyers pipe.

The tenders are of the Acme water-leg type and have a capacity for 8,000 gal. of water and 12½ tons of coal.

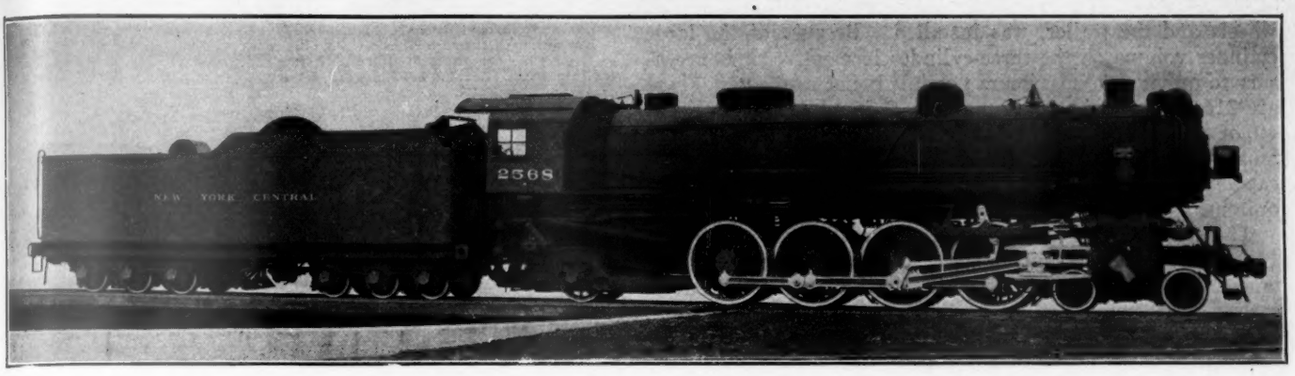
No official tests have been made with these new Mikado locomotives, although a number of very satisfactory preliminary runs were made to determine tonnage ratings. On one of these trial runs with increased tonnage up the Wilkes-Barre mountain from Pittston Junction, near Croxton, the train consisted of 60 loaded cars which gave a total tonnage of 3,856 tons back of the tender. This train was handled by one of the new Baldwin locomotives without a booster at the head end and two American helper locomotives with boosters, on the rear end. The train left Pittston Junction at 11.45 a. m. and arrived at the top of the mountain at 3.15 p. m., the distance being 20.5 miles, with a continuous grade of 61 ft. to the miles most of the way. Curves are compensated.

The previous Mikado locomotives have been rated at 950 tons on this grade, or 2,850 tons for three engines. It will be noted that on the trial where two of the engines were equipped with boosters, the tonnage handled was 1,006 tons in excess of the rating for the previous locomotives.

On another trial run, with a single locomotive equipped with a booster, between Pittston Junction and Mountain Top, the train consisted of 20 loaded coal cars, which gave a total tonnage back of the tender of 1,453 tons. This train left Pittston Junction at 12.10 p. m. and arrived at the top of the mountain at 4.15 p. m. The actual running time was 2 hr. 25 min., which corresponds to an average speed of a little more than 8 miles per hour.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Builder	American	Baldwin
Type of locomotive	2-8-2	2-8-2
Service	Freight	Freight
Cylinders, diameter and stroke	27 in. by 32 in.	27 in. by 30 in.
Valve gear, type	Baker	Baker
Valves, piston type, size	14 in.	14 in.
Maximum travel	6 in.	6 in.
Outside lap	1 1/16 in.	1 1/16 in.
Exhaust clearance	1/4 in.	1/4 in. lap.
Lead in full gear	1/16 in.	1/16 in.
Weights in working order with booster:		
On drivers	239,000 lb.	237,900 lb.
On front truck	29,500 lb.	29,300 lb.
On trailing truck	56,500 lb.	58,000 lb.
Total engine	325,000 lb.	325,200 lb.
Tender	164,500 lb.	151,800 lb.
Wheel bases:		
Driving	16 ft. 6 in.	16 ft. 6 in.
Rigid	16 ft. 6 in.	16 ft. 6 in.
Total engine	37 ft. 1 in.	36 ft. 6 in.
Total engine and tender	69 ft. .0¼ in.	68 ft. 5¼ in.
Wheels, diameter outside tires:		
Driving	63 in.	63 in.
Front truck	33 in.	33 in.
Trailing truck	45 in.	45 in.
Journals, diameter and length:		
Driving, main	11½ in. by 14 in.	11 in. by 14 in.
Driving, others	11 in. by 14 in.	11 in. by 14 in.
Front truck	7 in. by 12 in.	7 in. by 12 in.
Trailing truck	9 in. by 14 in.	9 in. by 14 in.
Boiler:		
Type	Straight-top	Wagon-top
Steam pressure	200 lb.	200 lb.
Fuel, kind	Soft coal	Soft coal
Diameter, first ring, inside	90 in.	82 in.
Firebox, length and width	120 1/16 in. by 90 in.	120 1/16 in. by 90 in.
Height mud ring to crown sheet, back	68½ in.	70 in.
Height mud ring to crown sheet, front	90½ in.	89 1/16 in.
Arch tubes, number and diameter	5—3½ in.	5—3½ in.
Combustion chamber length	46 in.	48 in.
Tubes, number and diameter	234—2¼ in.	254—2¼ in.
Flues, number and diameter	50—5½ in.	45—5½ in.
Length over tube sheets	17 ft. 6 in.	17 ft. 6 in.
Grate area	75.2 sq. ft.	75.2 sq. ft.
Heating surfaces:		
Firebox and comb. chamber	316 sq. ft.	336 sq. ft.
Arch tubes	41 sq. ft.	40 sq. ft.
Tubes	2,399 sq. ft.	2,606 sq. ft.
Flues	1,253 sq. ft.	1,128 sq. ft.
Total evaporative	4,009 sq. ft.	4,110 sq. ft.
Superheating	1,074 sq. ft.	980 sq. ft.
Comb. evaporative and superheat'g	5,083 sq. ft.	5,090 sq. ft.
Special equipment:		
Brick arch	Yes	Yes
Superheater	Type A	Type A
Feedwater heater	No	No
Stoker	Elvin	Duplex
Booster	On 5	On 5
Tender:		
Style	8 wheel-water leg	8 wheel-water leg
Water capacity	8,000 gal.	8,000 gal.
Fuel capacity	12½ tons	12½ tons
General data estimated:		
Rated tractive force, engine 85 p. c.	63,000 lb.	59,000 lb.
Rated tractive force, booster	11,000 lb.	11,000 lb.
Cylinder horsepower (Cole)	2,624 hp.	2,624 hp.
Boiler horsepower (Cole) (est.)	2,760 hp.	2,770 hp.
Speed at 1,000 ft. piston speed	35.2 m.p.h.	37.5 m.p.h.
Steam required per hour	54,600 lb.	54,600 lb.
Boiler evaporative capacity per hr.	57,450 lb.	57,660 lb.
Coal required per hour, total	8,528 lb.	8,528 lb.
Coal rate per sq. ft. grate per hour	113.3 lb.	113.3 lb.
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent	73.6	72.9
Weight on drivers ÷ tractive force	3.80	4.02
Total weight engine ÷ cylinder hp.	123.9 lb.	124.0 lb.
Total weight engine ÷ boiler hp.	117.8 lb.	117.5 lb.
Total weight engine ÷ comb. heat. surface	64.0 lb.	63.9 lb.
Boiler proportions:		
Boiler hp. ÷ cylinder hp., per cent	105	105.5
Comb. heat surface ÷ cylinder hp.	1.94	1.94
Tractive force ÷ comb. heat. surf.	12.38	11.58
Tractive force × dia. drivers ÷ comb. heat. surface	781	730
Cylinder hp. ÷ grate area	34.9	34.9
Firebox heat. surface ÷ grate area	4.75	5.00
Firebox heat. surface, per cent of evap. heat. surface	7.0	7.4
Superheat. surface, per cent of evap. heat. surface	21.1	19.2
Tube length ÷ inside diameter	104.5	104.5



The First Three-Cylinder Locomotive in America

New York Central Three-Cylinder Locomotive

4-8-2 Type for Freight Service, with Booster, Develops 75,700 Lb. Tractive Force; Adhesion Factor 3.73

FOR several months past the New York Central has been operating in freight service on the Mohawk division a three-cylinder simple locomotive of the 4-8-2 type. The design is similar to the two-cylinder Mohawk locomotives built in 1916 and 1917.* The locomotive was constructed by the American Locomotive Company for experimental purposes to determine whether the division of work between three sets of pistons, crossheads and main rods would be desirable in a heavy freight locomotive, as well as to determine whether the three cylinders will make possible an increase in thermal efficiency by more expansive use of the steam.

The locomotive has three simple cylinders, 25 in. in diameter by 28 in. stroke. The boiler is equipped with a Type E superheater, the Superheater Company's feedwater heater and a trailer booster. Including the effect of the booster, the maximum tractive force is 75,700 lb. The tractive force of the two-cylinder Mohawk type is 51,400 lb.

Since this is the first application of the three-cylinder principle on a heavy freight locomotive in this country, it may be of interest to review briefly the advantages of this type from the mechanical standpoint. Among the most important benefits is the reduction of stresses on each set of pistons, crossheads and main rods. In this case, while the three-cylinder arrangement increased the tractive force 21 per cent, it also reduced the piston thrust, based on 200 lb. pressure, from 123,000 lb. to 98,000 lb., or 20 per cent. The even turning moment on the driving wheels obtained with three cylinders is also advantageous in permitting the use of higher tractive force with the same weight on drivers. In any locomotive, the adhesive weight must be great enough to prevent slipping with the maximum tractive force developed throughout a complete revolution. In a three-cylinder locomotive, the maximum is only 8 per cent higher than the average, while with two cylinders, it is 23 per cent above. This means that for a given weight on drivers the three-cylinder locomotive can develop 15 per cent greater rated tractive force than a two-cylinder design without increasing the tendency to slip the wheels. The factor of adhesion used on the three-cylinder locomotive is 3.73, which would be equivalent to about 4.29 in the two-cylinder type. In Great Britain and Germany, where the three-cylinder arrangement has been extensively used, it is claimed that the six exhausts per revolution have a marked effect in increasing the efficiency of combustion.

Details of Construction

The two outside cylinders of the locomotives are placed horizontally with the center lines 2 in. above the centers of the wheels. In order to avoid using a main rod passing around the front axle, the center cylinder has been inclined at an angle of 8½ deg., with the center line passing about 4 in. above the center of the main axle. This brings the front end of the cylinder higher than the bottom line of the boiler barrel and the bottom side of the smokebox has been raised at the forward end to give the required clearance. The right and center cylinders and valve chambers are made in a single casting which extends to the inner side of the left frame where it is bolted to the left cylinder casting.

The crank axle is of the built-up type, with step-fits in the crank cheeks. The inside crank pin has a bearing 7½ in. wide by 12 in. in diameter. This bearing is lubricated with hard grease, which is forced in from the outside of the axle and passes through holes in the crank cheeks and the center crank pin to the surface of the bearing. The center guides, which are of the two-bar type, are lubricated through oil pipes from the running board.

One of the interesting features of the design is the method of driving the valve for the inside cylinder from the outside valve gear. The center lines of the three valves are all horizontal and at the same height. A transverse forked lever is placed ahead of the cylinder castings, one end of the lever being connected to the front extension of the left valve stem, the stationary fulcrum being one third the distance from the opposite end. The right-hand end of this lever forms a fulcrum for the center of a floating lever, one end of which is connected to the right valve stem, while the other end drives the valve for the center cylinder. This simple arrangement avoids the necessity for the third set of valve motion. In order to facilitate the application of the valve motion levers, the bumper beam braces are secured by pins at the top and bottom ends, making them readily removable.

Double ported piston valves, 11 in. in diameter, are used for all three cylinders. The valves have a maximum travel of 6 in. with 1⅛-in. lap, ⅛-in. exhaust clearance, and 3/16-in. lead.

To permit the application of the booster a cast-steel Delta type trailer truck with equalizers between the driving

*For a description of these locomotives, see the *Railway Mechanical Engineer* for February, 1918, page 77.

wheels and the trailer, was installed. Because of the large cylinder volume on the three-cylinder locomotive, it is necessary to provide the maximum possible boiler capacity. There are 216 flues 3½ in. in diameter by 2 ft. 11 in. long, all but 40 of these containing superheater units. The use of the Superheater Company's feedwater heater also increases the capacity of the boiler and helps to bring it up to the requirements of the cylinders.

The tender used with this locomotive has a capacity of 15,000 gal. of water and 16 tons of coal. It is of the rectangular, water-bottom type and has a cast-steel frame carried on Commonwealth six-wheel trucks.

It is expected that dynamometer tests of the three-cylinder locomotive will be conducted during the next few weeks, which will give an opportunity for comparing its performance with that of two-cylinder locomotives from the standpoint of hauling capacity and fuel consumption. Operation over a more extended period is necessary to enable any estimate to be made of the relative expense of maintaining three-cylinder locomotives as compared with the ordinary two-cylinder design of the same capacity.

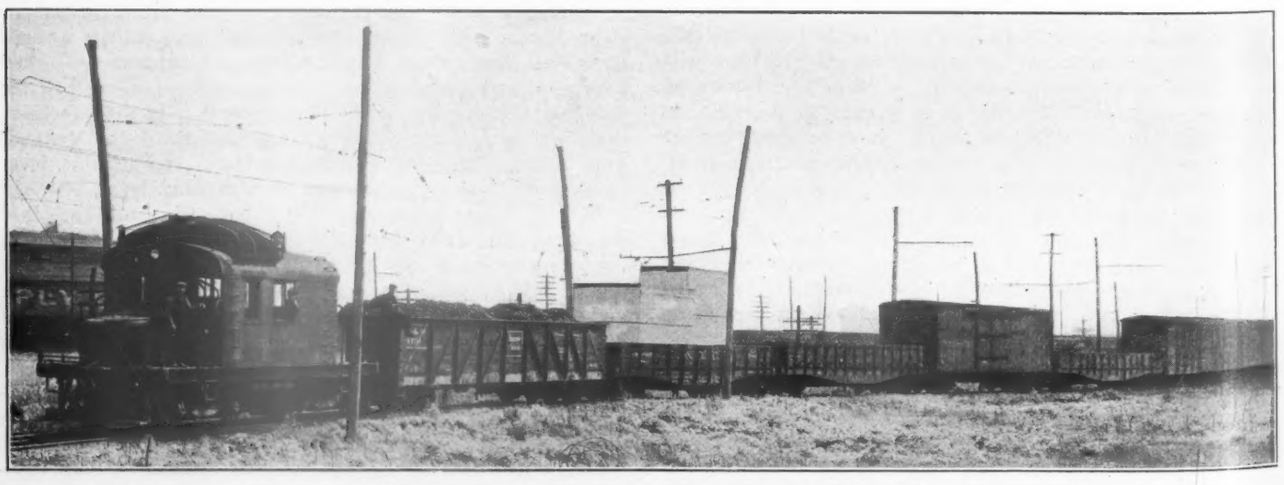
TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Type of locomotive	4-8-2
Service	Freight
Track gage	4 ft. 8½ in.
Cylinder, diameter and stroke	3—25 in. by 28 in.
Valve gear, type	Walschaert
Valves, type, size	Double ported Piston—11 in.
Maximum travel	6 in.
Outside lap	1⅛ in.
Exhaust clearance	⅛ in.
Lead in full gear	3/16 in.
Weights in working order:	
On drivers	241,500 lb.
On front truck	66,000 lb.
On trailing truck	59,500 lb.
Total engine	367,000 lb.
Tender	267,800 lb.
Wheel bases:	
Driving	18 ft. 0 in.
Rigid	18 ft. 0 in.
Total engine	40 ft. 7 in.
Total engine and tender	82 ft. 6 in.
Wheels, diameter outside tires:	
Driving	69 in.
Front truck	33 in.
Trailing truck	45 in.
Journals, diameter and length:	
Driving, main	11½ in. by 13 in.
Driving, others	11 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Conical
Steam pressure	200 lb.
Diameter, first ring, inside	80 in.
Firebox, length and width	114¼ in. x 84½ in.
Arch tubes, number and diameter	4—3 in.
Combustion chamber length	None
Tubes, number and diameter	None
Flues, number and diameter	216—3½ in.
Length over tube sheets	24 ft. 11 in.
Gas area through tubes	328 sq. in.
Net gas area through flues	1,054 sq. in.
Total gas area through tubes and flues	1,382 sq. in.
Grate area	66.9 sq. ft.
Heating surfaces:	
Firebox and comb. chamber including arch tubes	242 sq. ft.
Tubes and flues	4,913 sq. ft.
Total evaporative	5,155 sq. ft.
Superheating	2,158 sq. ft.
Comb. evaporative and superheating	7,313 sq. ft.
Special equipment:	
Brick arch	Security
Superheater	Type E
Feedwater heater	Superheater Co.
Stoker	Elvin
Booster	Franklin
Tender:	
Style	Rectangular
Water capacity	15,000 gal.
Fuel capacity	16 tons
Trucks	6 wheel
General data estimated:	
Rated tractive force, 85 per cent	64,700 lb.
Tractive force of booster	11,000 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	65.8
Weight on drivers ÷ tract. force	3.73
Total weight engine ÷ comb. heat. surface	50.2
Boiler proportions:	
Tractive force ÷ comb. heat. surf	8.85
Tractive force × dia. drivers ÷ comb. heat. surface	611
Firebox heat. surface ÷ grate area	3.62
Firebox heat. surface, per cent of evap. heat. surface	4.70
Superheat. surface, per cent of evap. heat. surface	41.9

Gasoline Electric Locomotive

WORK on the development of gasoline-electric locomotives, halted by the war and subsequent activity, has been resumed by the General Electric Company. A new 40-ton unit embodying marked improvements in design and construction over previous types was completed recently; a simple throttling controller without resistance makes it possible to use the full power of the engine at all speeds. Comprehensive tests have been given the new locomotive, which show it to be more economical in operation than mechanical drive locomotives of the auto bus type. Nine months' operating results indicate that the maintenance costs will also be very low.

The locomotive is expected to find wide application on steam road branch lines for freight and passenger service, switching, haulage, etc. It is equipped with four GE-820, 500-volt, 60 hp. mine type motors operating from a 100 kw. generator direct connected to a Sterling six-cylinder Dolphin engine. The locomotive has a double end control. The running gear consists of two, four-wheel, swiveling, arch bar trucks with floating bolster. G-E straight and automatic air brake equipment is furnished, including a 600-volt motor-driven compressor. An auxiliary ratchet type hand brake is also furnished.



Gas-Electric Locomotive Hauling a 353-Ton Trailing Load

Transportation—Master Key to Progress*

General Prosperity Will Follow if Railroads Are Properly Encouraged to Improve Their Service

By Edward J. Kearney
President, National Machine Tool Builders' Association

MACHINE tools are called, and rightly so, the "master tools of industry;" but they are not a primary product, creating their own demand, or connected, except indirectly, with individual consumption. It is not known among businessmen generally that the machine tool industry suffers during the downward swing of the business cycle to a far greater extent than ordinary manufacturing lines, for the reason that our product is bought mainly during periods of expansion. The carpet-sweeper manufacturer, when his business shrinks 5 per cent, buys no more machine tools, so that our business, as far as he is concerned, falls 100 per cent. The example could be extended almost indefinitely. Is it any wonder that we are asking one another "What is the next development that will sustain the machine tool industry?" Every one has an answer. I have mine. It is general, mechanical, industrial, and agricultural development and prosperity, with *transportation the master key to progress.*

Future progress depends on adequate transportation facilities. So important is this that it should be a matter of the most serious concern of every businessman and citizen. It is this that leads me to present an outline of the case and show where we can do something for ourselves and in the public interest.

There are few people not actively connected with railways or who have not made a study of their growth, who have any idea as to the enormous extent to which transportation in this country has grown, or to where it will lead with the present rate of growth continued. This is why we should be concerned.

Passenger Traffic

It seems to be a part of our national genius to travel. For example, the Iowa farmer, when the corn crop is good and hogs are high, spends the winter at Long Beach, California. The Colorado school teacher spends her vacation attending summer school at Columbia University. The Ohio business man goes South for a late and an early game of golf, and all the newly-weds see Niagara.

In addition, the system of marketing our products has brought about extensive travel on the part of representatives of manufacturing concerns, wholesalers, and others, so that railway travel, in spite of the coming of the automobile, is growing rapidly. In 1880 the per capita travel was approximately 100 miles, which has continued to grow steadily until it is now about 400. The number of passenger-miles traveled at the present time is over eight times what it was in 1880.

Freight Traffic

In freight, we find a similar condition with the difference that the rate of increase is much more rapid. The per capita ton-miles rising steadily during the period, multiplied itself about six to one. In 1880 the number of tons of freight hauled one mile was 32 billion while it is estimated that for 1923 it will be beyond 415 billion or 13 times as much.

Some investigators are of the opinion that the length of haul will diminish, owing to the tendency to establish factories in other than strictly industrial sections and nearer the point of consumption. This would have the effect of keeping down the ton-miles as compared with the number of cars loaded. But, on the other hand, the motor truck is taking away many short hauls, tending again to lengthen the average haul. At present the products of the mine, forest, and farm furnish 70 per cent of all freight. State traffic furnishes but 15 per cent of the whole, while interstate traffic furnishes 85 per cent. In this discussion passenger traffic would be eliminated, but people will and must travel, and the high-speed trains furnished for their accommodation clutter up the tracks, increase the time and cost of getting slower freight, and consequently increase the number of freight cars and locomotives necessary for a given volume.

Future Transportation Requirements

Every factor in the economic progress of our country points to greater production, greater wealth, and higher standards of living; consequently, greater consumption, necessitating more and better transportation. There are ample grounds for the prediction that within 20 years we shall demand of the railroads the moving of twice the amount of freight carried today, or more than 800 billion ton-miles. In addition, they will be called on to provide for a 75 per cent increase in passenger-miles traveled. Given the vitalizing power of sustained credit, without which nothing can be done, is it a task capable of accomplishment? Will it be possible in this space of time to provide facilities to dispose of this overwhelming volume? Are there any improvements in sight that, if applied, will help to a solution?

[Attention was here called to the economies obtained by improvements in locomotive design and the introduction of superheaters, feedwater heaters, water rectification, thermic syphons, boosters and improved brake equipment. The possibilities of electrification and the need of increased sidings, switches and signals was also referred to.]

Keeping the Equipment in Service

One of the greatest economies in railway operation is to keep the equipment in use the greatest possible amount of time. In our own business we recognize the value in reduced overhead when our equipment can be used full time, or better still with more than one shift. The same is true of railway equipment. In order to bring this about, there must be facilities for taking care of locomotives at the terminals so that they will be the least possible time out of service. This means better and larger roundhouse facilities, sanding and coaling devices, boiler washing equipment, and last, but certainly not least, modern machine tools for both the roundhouse shop where temporary and emergency repairs are made, and for the general shop where thorough overhauling is done.

Is Management Incompetent?

Reference is frequently made in certain quarters to the incompetency of railroad management. Let us see as to that. Since taking back the roads from the government on March 1, 1920, the number of employees has been reduced by 150,000, while the amount of traffic being moved at the present moment is the largest in history, with a steadily rising car surplus. This hardly looks like incompetence.

The only thing that stands in the way of growth of transportation facilities is lack of capital. The capital will be

*From an address before the National Machine Tool Builders' Association, at Lenox, Mass., October 3, 1923.

forthcoming if there is prospect of security for the investment and a continued satisfactory return compared with what can be obtained in other industries. The selling methods of our political leaders have not improved as rapidly as have those of the makers of some less important commodities, with the result that the people are misinformed and led to believe false economic doctrines. When any considerable class is adversely affected, such for example, as the wheat growers or the coal consumers, what is the first suggestion for relief? Take it out of the railroads.

Commission Has Double Responsibility

In the Transportation Act of 1920, Congress places the regulation of the railroads in the hands of the Interstate Commerce Commission with instructions to see that no injustice is done any shipper; also charges them with an equally important duty of seeing that the railroads receive a return which will attract capital sufficient for adequate growth and development.

Mechanically the railroads are on the way to handle the ever-increasing volume of traffic and to do it so much more economically as to give promise of ultimate freight rate reductions. Our opportunity is in using our influence with those in authority to promote and maintain a government policy favorable to the development of transportation, the master key to progress. Vital to mechanical progress by the railway is the investment of vast capital. Underlying such investment is confidence in the stability of railway income. Behind this in turn is stability of government policy. Efforts are being made to repeal the act or so to amend it that the revival of railroad credit will be impossible and public interest suffer irreparable damage. Some men in public life do not seem to know that one dry bearing will be just as disastrous to the operation of the whole machine as if no oil were used at any point. The immediate objective is a further trial of the Transportation Act without experimental amendments. In future years the objective is so to guide the progress of perfecting the law that always embedded in it will remain the principle of net income adequate for the attraction of investment capital.

Can you not picture a shrinking map with the Missouri valley products only 48 hours from Atlantic harbors? Can you not visualize with the prosperity incident to these developments an enormous increase in the use of mechanical equipment on the farm, in the home, on the railway, in the air—wherever there are tasks for human hands to perform? Does this not mean that the manufacture of machine tools will become a more stabilized industry depending less on the activities of any one line and more on the general prosperity of all the people?

Ramsay Turbo-Electric Condensing Engine

An Interesting Experimental Locomotive Which Has Been Under Development in England for Two Years

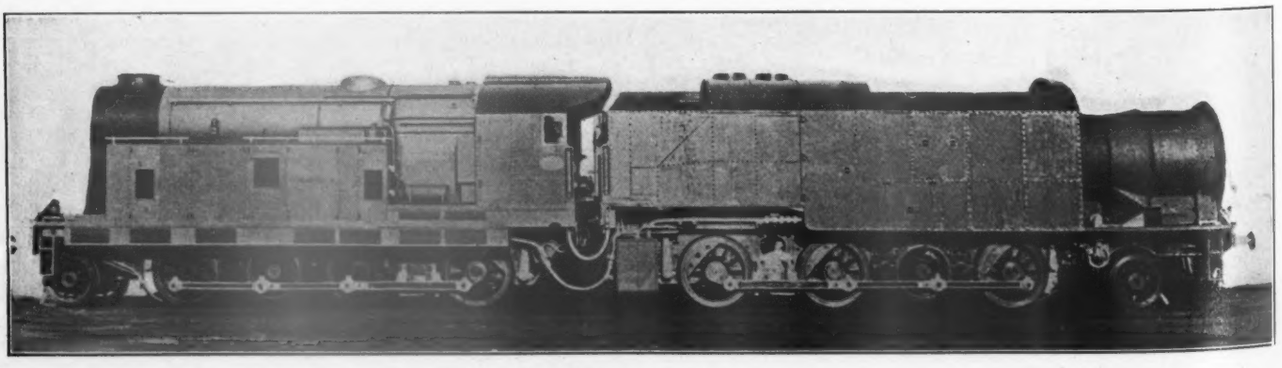
THE Ramsay turbo-electric condensing locomotive was built by Sir W. G. Armstrong, Whitworth & Company, Scotswood Works, Newcastle-Upon-Tyne, Great Britain, in 1921 for the Ramsay Condensing Locomotive Company. This locomotive was designed for experimental purposes and during the past 18 months has been submitted to numerous stationary and road tests, various modifications being made from time to time as experience dictated. The results have been so encouraging, however, that a new locomotive embodying the same principles is now being designed. While several references have been made to this interesting locomotive, only the most general data has thus far been published.

The locomotive is 69 ft. 7½ in. long overall, weighs 293,000 lb. in working order and has a rated tractive force of 22,000 lb. It consists of two sections connected together by a universal joint. Each section is carried on three pairs of driving wheels and a two-wheel truck. The front section contains the boiler under which is placed the main turbine and generator and the auxiliary turbine and generator, while the back section contains the condenser with fan, water tanks and coal bunker. Communication between the turbines and condenser is by way of an exhaust pipe which is provided with a flexible rubber connection reinforced with aluminum rings.

Power is developed in the main turbine and the transmission of power from the turbine to the locomotive wheels is by electrical means. The turbine is coupled to an electrical generator, the electrical energy from which is transmitted to four motors, two of which are fitted to the wheels of the front section and two to the wheels of the rear section.

The main turbine is of the impulse type and contains nine stages, the mean blade diameter being 36 in. It is designed for a steam pressure of 200 lb. per sq. in., superheated 300 deg. F., and exhausting to a vacuum of 27½ in. The maximum speed of the turbine is 3,600 r. p. m. The main turbine drives a three-phase generator, which is designed to develop 890 kw. at 3,600 r. p. m., the pressure then being 600 volts.

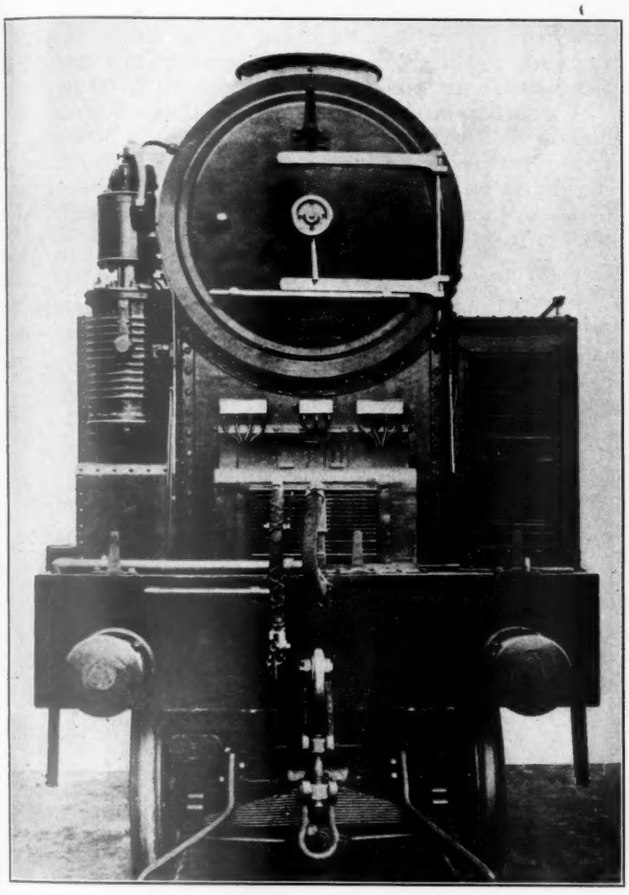
The auxiliary turbine, which is a single stage one, drives a direct-current dynamo, which excites the poles of the main



Ramsay Turbo-Electric Locomotive of 22,000 Lb. Tractive Effort

generator and also provides electrical energy for the motors driving the condenser fan, the condenser rotor and the extraction pump and also the current for lighting the train. This turbo-set runs at 3,600 r. p. m. and is subjected to the same steam conditions as the main turbo-set.

The boiler is supplied with air by a forced-draft fan placed in the cab. The grate area of the boiler is 28.5 sq. ft.; the heating surface, 1,243 sq. ft., and the superheater surface 300 sq. ft.



Front End View of Ramsay Locomotive

The Condenser Design

The condenser consists of an annular nest of tubes built into two headers; the exhaust steam from the turbines enters one header, passes through the tubes, is condensed and the water resulting from the condensation is collected in the other header. From there the water passes into a well and is returned to the boiler to be converted into steam again.

The accelerated evaporative principle is employed in the condenser. The nest of tubes is in the form of a drum which rotates in bearings. The drum is housed in a tank, the bottom of which contains water kept at a constant level by a pneumatic float valve. The tubes pass through the water as they rotate. After they leave the water, rapid evaporation is produced by passing air over them at a high velocity and the result is a correspondingly rapid condensation of the steam inside the tubes. The air is supplied by a specially designed fan. The inlet to the fan has a scoop or air guide which forms an easy path for the entering air and so eliminates the losses from the shock which would occur if no such provision were made.

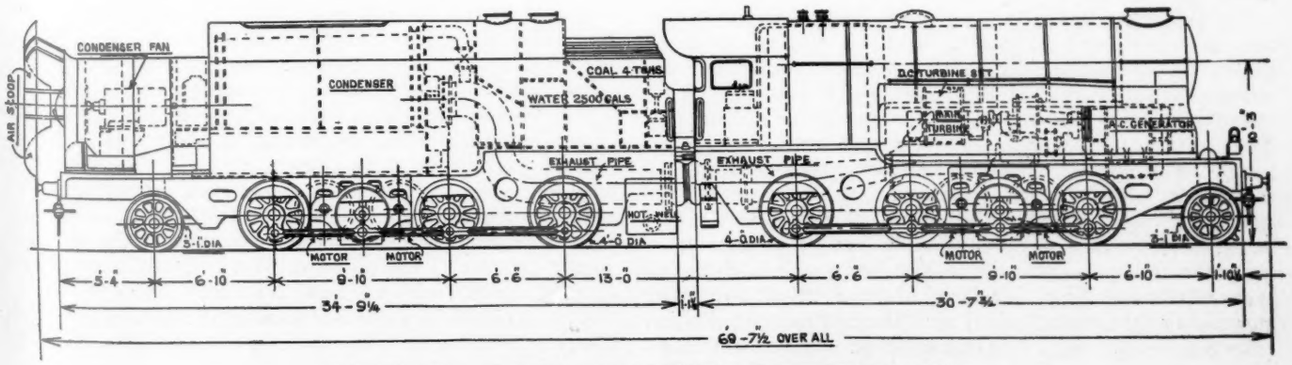
The water used in the boiler and that used for wetting the tubes are kept separate. The former is used in a closed circuit and is not wasted except by small leakages, hence very little new water is required. The advantage of this is specially felt where locomotives are obliged to use bad water which results in rapid deterioration of the boiler. By using a condensing system, taking in bad water during runs is obviated as ample water can be carried to satisfy any run that the locomotive may be called upon to perform. A prolonged life of the boiler is insured in any case by using a condensing system because shortly after the run the feedwater becomes partially distilled. Wetting the tubes by impure water does not affect the vacuum, neither does it injure the tubes. Repeated tests having shown this to be the case, any water may be used for condensing purposes.

Photograph by Railway Gazette, London

Locomotive Ready to Back Onto a Passenger Train

The Electric Driving Motors

The four main driving motors are of the alternating current slip-ring type, ventilated by fan runners mounted on the rotor shafts. The continuous output capacity of each is 275 brake hp. with one hour's rating at 360 brake hp. The speed of the motors at 60 m. p. h. is 1,175 r. p. m. and the pressure 600 volts. Each pair of motors is belted to a center stretcher



Side Elevation of Ramsay Turbo-Electric Condensing Locomotive

carrying a transmission shaft and spur wheels. Pinions are keyed to the motor shafts and these gear with the spur wheels, the power being transmitted through coupling rods from the spur wheels to the driving wheels in the ordinary manner.

The following are the tractive efforts at the rim of the wheels for the acceleration period from starting to 60 miles per hour.

Speed, m. p. h.	Tractive Force
Starting	22,000 lb.
15	22,000 lb.
30	11,050 lb.
60	8,600 lb.
Normal running	
60	6,000 lb.

The starting torque of the motors is about three times that of the normal and it is obtained as follows: Before starting the locomotive, the auxiliary turbine is run up to full speed, thus providing excitation for the main generator and energy for the auxiliaries. The main turbine is then run up to half speed; viz., 1,800 r. p. m. At this period the motors are connected in cascade. It is then that the locomotive may be started.

When a turbine speeds up from rest to full speed its torque decreases in the ratio of two to one, and when passing through half speed its torque is one and a half times the normal and this is the torque of the main turbine when running at 1,800 r. p. m. Again, two alternating current motors when connected in cascade and running at half the speed of the generator have twice the turning moment which they have when connected in parallel with the same power consumption. Therefore, with the motors in cascade and the turbine running at half speed, the torque from rest to quarter speed will be two times one and a half, or three times the normal torque. The motors are now connected in parallel, the turbine still running at half speed, and the speed of the locomotive increases from one quarter to one half speed, the torque at the latter speed being 1.5 times the normal. After this the turbine speed is brought up to its maximum and the torque drops from one and a half times the normal to normal.

Photograph by Railway Gazette, London

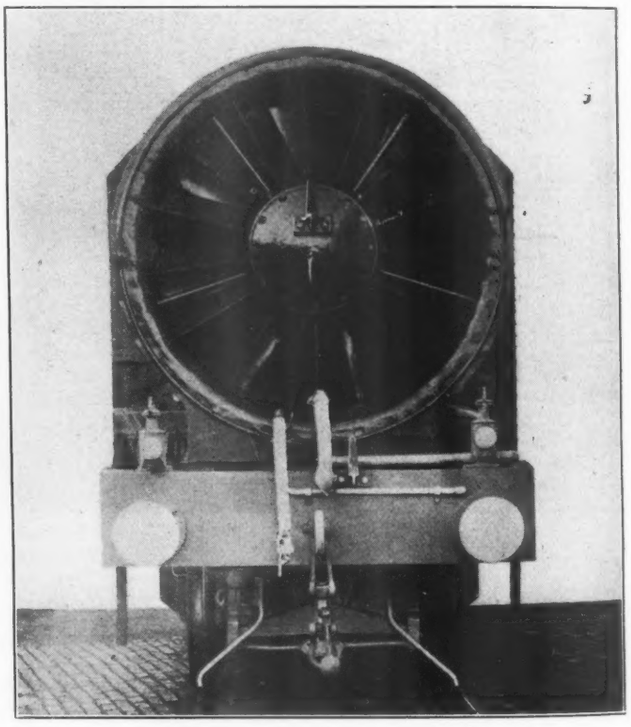
View From Rear Showing Air Scoop

In controlling the speed from rest to 60 m.p.h., the main and auxiliary turbines having been brought to speed by means of a handwheel in the cab, which regulates the steam inlet, all control of the locomotive is now carried out electrically by means of the control wheel on the controller fixed in the cab, the main turbo-generator running at 1,800 r.p.m. The control wheel being in the zero position, the motors are without current and connected in cascade. To start the locomotive, the control wheel is moved to the first notch, thereby closing the excitation circuit to the turbo-generator and connecting the motors in cascade, with resistances wholly in circuit. Resistance is now cut out by further movement of the control wheel until the first running position 15 m.p.h. is obtained. If a greater speed is desired, the control wheel is further moved to alter the motor connections from cascade to parallel, the excitation circuit again being closed; the motors once more operate under current resistance again being cut out until a second running speed of approximately 30 m.p.h. is reached. Additional notches are provided on the controller, each of which corresponds to a given speed of the locomotive. These speeds are reached by further moving the control wheel round, step by step, whereby the setting of the main turbine governor is correspondingly altered, i.e., the speed of the turbo-generator is increased and thereby the periodicity. In this matter, the locomotive speed can be increased from 30 to 60 m.p.h.

A reduction in the speed of the locomotive is obtained by turning the control wheel quickly back to the zero position, thus observing the reverse succession of notches to those for starting up to full speed. The excitation circuit being thereby opened, the notches are without current and connected in cascade ready for starting up again.

Results of Tests

The present locomotive is, of course, purely an experimental one and for demonstration purposes. The trials have been very exhaustive and have extended over a period of 18 months or more.



Rear View of Ramsay Locomotive With Air Scoop Removed to Show Condenser Fan

By disconnecting the terminals of the generator from the motor and connecting them to water resistances, the turbine and generators can be run when the locomotive is at rest, the electrical energy being dissipated by heating up the water. This affords a convenient means of testing the condenser and taking readings which would be difficult to obtain while running. Numerous tests have been made under these conditions and considerable valuable data collected. In addition to these tests, many runs have been made between Horwich and Bolton and others between Horwich and Southport. During all these runs, a breakdown has never occurred. On one of the runs a distance of 100 miles was traversed and a speed of 60 m. p. h. attained with a load of 275 tons.

The efficiency of a turbo-condensing locomotive mainly depends on the design and operation of the condenser. Tests

have shown that a condensing apparatus can be placed within the confined space of the locomotive which will maintain the required high vacuum necessary to deal economically with large loads.

Selling Safety to the Man on the Firing Line*

By W. N. Doak
Vice President, Brotherhood of Railroad Trainmen

THE peace of mind of the individual plays a more important part in our successful endeavors than one may imagine at first glance. Worries of any character will no more mix successfully with railroading than will water with oil. Many things may cause worry or disturbed condition of mind. The more frequently brought to my attention are those concerning the administration of discipline and the personal handling of employees by superiors. Train delays of apparent unnecessary duration, partiality and favoritism, together with over-zealousness on the part of officers and fellow employees, many times tend to disturb the peace of mind of employees, and as a result carelessness and indifference follow with the attending allies, accidents, resulting in injuries, death or property destruction. Weed out elements of discord as you would the tare from the wheat.

Security in employment is of paramount importance to successful performance of duty. Were each employee, who is worth while, properly impressed with the fact that he is secure in his position so long as he obeys instructions, lives up to the rules and is careful, we would find the best results following. Above everything, eliminate the feeling of "It's hell if you do and hell if you don't." This spirit will not only wreck your safety efforts, but as well, the success of your industry.

Good wages, properly and discriminatingly distributed in such a manner as to compensate in proportion to the services performed, are of such magnitude that we may well turn our attention to them as having the most telling effect in the operation of trains and the general safety first movement. Safety first principles demand that we all boost for fair wages as the best step toward responsibility, and recognized responsibility leads to safety.

All movements contemplating changes in thought and action are slow, and in general the safety movement has been slow, but fortunately progressive and forward. Your safety first movements were regarded at one time as unsound theories, or hobbies. However, recently I was told by a high official of an important railway that the best asset his line had and the biggest dividend payer was the safety first movement. Others have told me that through the good work of their safety first movements they had turned losses into profits—thus disproving the old theory of these movements being expensive.

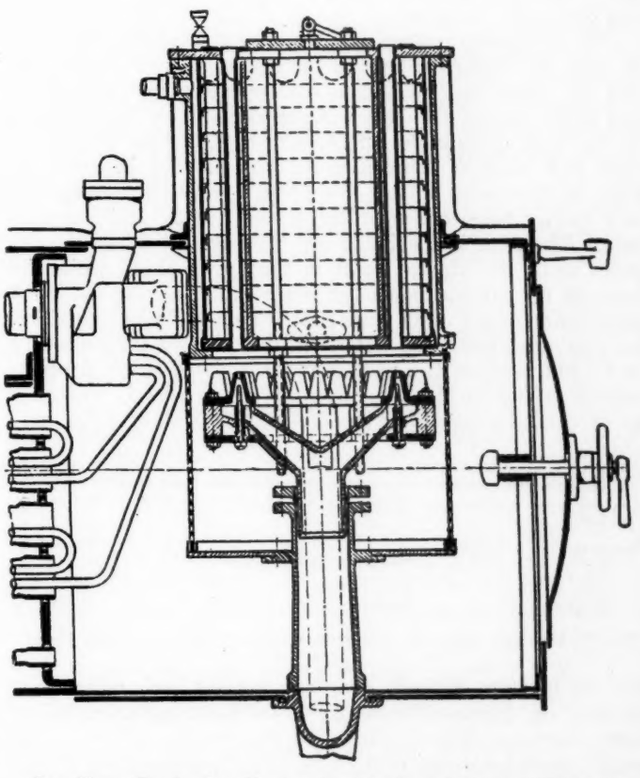
Labor organizations, such as ours, at first looked with some skepticism upon the safety movement but have now so far changed their viewpoint that "safety matters" are not only a part of their work, but an order of business in their ritual, thus making it an important part of organization work. The reason for this change of opinion is education and fair dealing. The results are written in undeniable evidence on our accident records and insurance reports—thereby proving that the movement has had tangible value to us from a purely organization standpoint in dollars and cents.

An erroneous idea has been too long prevalent in this country that the railroads and their employees were pitted against each other. Of course, there has been the desire on the part of some to cause friction in the hope that these two may not unite for mutual benefit and protection. There is no industry on earth where closer co-operation should prevail than between investor, management and employees of the railroads. Their interests are common and they should be encouraged in their efforts of co-operation. The only reason they are encouraged to do other than work together is because some outsider desires to profit by their differences. It is not only safety, but it is safety first to assist in uniting these principles in this great industry behind the common cause for the common good. In selling safety to the men on the firing lines, instill in them the spirit of co-operation and confidence.

*Abstract of an address before the meeting of the Steam Railroad Section of the National Safety Council, held at Buffalo, N. Y., October 2, 3 and 4.

Gas Type Feedwater Heater

A NEW type of small locomotive, built by A. Borsig, Berlin-Tegel, for the Voldagsen-Duingen-Delligsen light railway, was described in a recent issue of the German technical paper Verkehrstechnik. Among the new features of this locomotive is a smokebox feedwater heater, shown in the illustration. The hot gases enter the heater through a circular perforated cylinder and are entrained by an annular series of steam jets placed below the vertical smoke tubes of the heater. The water space of the heater has a series of light horizontal baffles. An internal smoke tube



Gas Type Feedwater Heater for Small German Locomotive

type of superheater is also fitted. The feedwater, delivered by an automatic pump, first passes through an exhaust steam feedwater heater of the Knorr type, where its temperature is raised to about 195 deg. F. It then circulates through the smokebox feedwater heater and its temperature is further increased up to 265 to 285 deg. F. Compared with the old saturated steam type of locomotive commonly in use on light railways, the new locomotive is said to show about 40 per cent saving in fuel.

Determining Water Readings in Locomotive Boilers

By William Hall

WHY do boilers explode? It is due to low water or to faulty indication of water in the boiler? After an explosion, and if the engineer and fireman live to tell the tale, they will say, nine times out of ten, that the glass showed an ample supply of water. They are no doubt honest in their assertions, but was the water glass honest in its indications?

It is a well known fact that some engineers dislike to carry too much water as it enables them to carry more steam, others carry too much, and consequently are working water through the cylinders, washing away lubrication. Also in cases where they have a long up-hill drag, they run the water at the lowest possible point. This in itself is not a safe practice, especially if at the top of the hill they immediately start to descend again, for while climbing the hill the crown sheet was covered with water, but when the dip down came the water rushes from the crown sheet towards the front end of the boiler, leaving the crown sheet dry, in some cases with disastrous results. It is not to be supposed that the engineer was wilfully negligent, but being anxious to get his train over the road, which is very commendable, he will take a chance on allowing the water to get low, depending upon the injectors to bring the water past the danger point as soon as he reaches the top. We all know that injectors will fail sometimes, and should it happen at the critical moment then the inevitable happens.

The recognized method of getting the water level of a boiler is, first, by taking the level of the boiler. How? By removing the dome cap or the man hole cover, trying the level on the joint. When the boiler is supposed to be level, then a rubber hose of suitable length, with a glass tube inserted in each end (a mark being filed on each tube ⅝ in. from the end) is filled with water. Two men are required to operate this rubber hose, one man inside the firebox and one outside. The man inside holds one tube against what he supposes to be the highest point of the crown sheet, while the man on the outside holds the other end, ready to mark off the location of the water glass cock. This in theory is alright, for everyone knows that water will find its own level when at rest. But here are two men from 10 to 15 ft. apart, the man outside trying to listen to the man inside who is supposed to be carefully watching his tube. Under these conditions

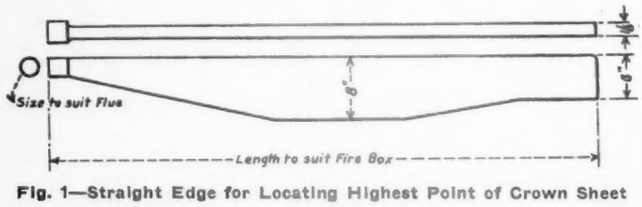


Fig. 1—Straight Edge for Locating Highest Point of Crown Sheet

hearing is quite difficult, they can not see each other, and yet they are trying to locate one of the most important boiler safety devices. We can imagine the result. If one man could handle both ends of the tube or both men could see both ends of the rubber hose I would have more confidence in the safety of the device, but under the present system, I have none. I do not believe it is a reliable method; in fact I have seen a variation of from 1 in. to 1½ in. by this method.

The following method has been tried and found to work out very satisfactorily: A straight-edge was constructed as per sketch, Fig. 1, long enough to reach from the back flue sheet and project about 2 ft. through the fire door hole, the front end being of a diameter to fit one of the flues. It is not necessary to have the boiler absolutely level, as the straight-edge should be set at the same angle as the boiler; this being taken with a long adjustable spirit level. An adjustable gage, Fig. 2, is then taken by an experienced boiler maker and the highest point of the crown sheet located. He then transfers the gage to the outside and marks off the highest point of the crown sheet on the back head. After this he proceeds the same as when using the rubber hose. The method is extremely simple and absolutely safe. There is no guess work about it.

This gage should have several lengths of pointers to cover the variations in fireboxes. Care should be taken in making the straight-edge, provision being taken to prevent warping, etc. It should be well braced and when not in use kept

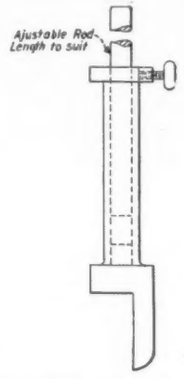
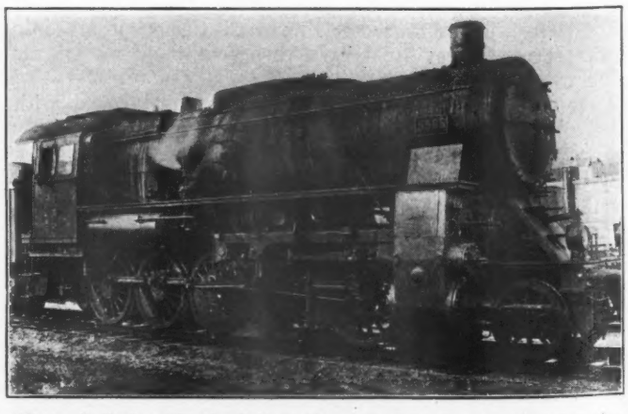


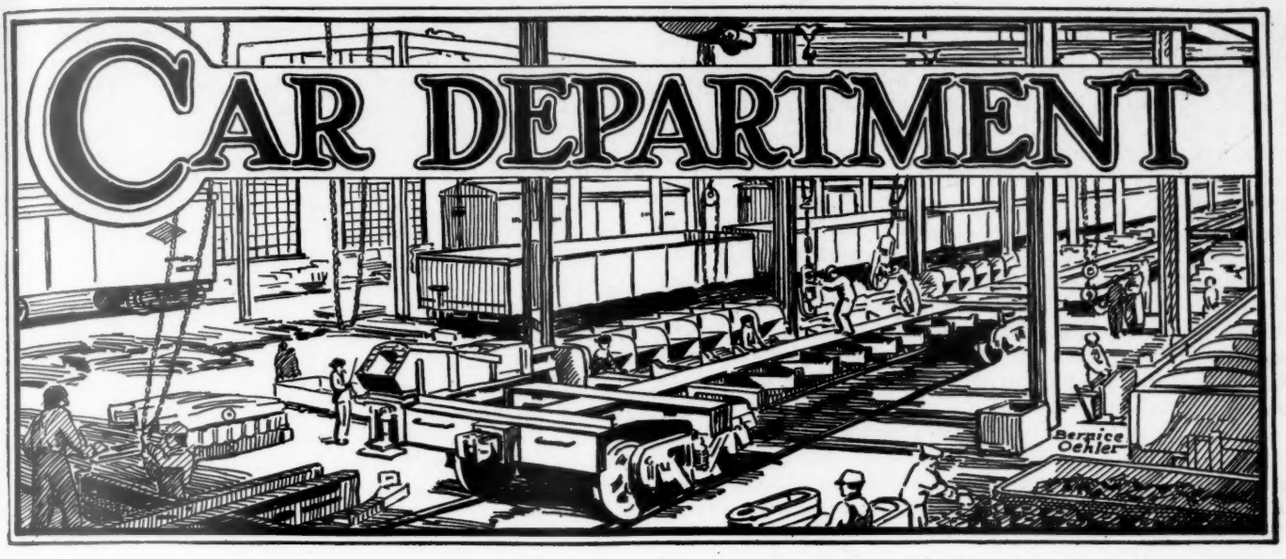
Fig. 2—Adjustable Height Gage for Crown Sheet

in a place where it would not be subject to danger of being misused, and should be kept for this purpose alone.

Where is the proper place to take the level of boiler from? Some take it from the dome joint, some from the man hole joint, which may be O. K. providing these joints have been set in the boiler level with the top of the wagon top or straight with the shell of the boiler. As most boiler explosions occur around the firebox, I believe the straight part of the wagon top is the logical place from which to level the boiler. It is easy of access at any and all times and while it may cost a little money to strip the wagon top for this purpose it is money well spent and wisely, for what is such cost compared to that of an explosion and possible loss of life. Objection may be made to having to take down the brick arch, in fact that objection has been raised, but what is the cost of rebuilding a brick arch, to the performing of a most important function, the accuracy of which may save the loss of many lives, besides a very large monetary loss to the company.



Three-Cylinder Simple 2-10-0 Type Freight Locomotive for the German State Railways



Substitutes for Turpentine and Linseed Oil

Practical Tests Indicate that Improvement Is Being Made in the Quality of These Products

THE Committee on Tests of the Equipment Painting Section of the Mechanical Division, American Railway Association, in its report presented at the Cleveland meeting of the Section, held on September 4, 5 and 6, gave the results of a number of tests of substitutes for turpentine and linseed oil. The tests were reported by the members of the committee individually and abstracts of these reports are given below.

Turpentine Substitutes

Six samples of substitutes were submitted for test.

Of these six samples only three could be classed as somewhere near satisfactory for all purposes. Some were discarded on account of extreme high boiling point; one on account of low boiling point; the others on account of obnoxious odor.

These three samples classed as satisfactory were tested, for specific gravity, residue, initial boiling point, evaporation, moisture, color and odor.

The typical constants of sample No. 4, which is one of the three satisfactory samples, as compared with pure gum turpentine, classes very favorably for general use. While it has a slightly higher boiling point than turpentine, it requires no more time for complete evaporation and hardening than does turpentine. Also, while 95 per cent distills over below 190 deg., C., the absence of excessively high boiling materials in its construction is assured and actual tests for rate of evaporation when used with body color and varnish films, show that the percentage of evaporation of this sample equals that of turpentine after two hours' exposure of film, while the immediate or initial evaporation is a little slower. The slower initial evaporation should not be considered disadvantageous for paint and enamel, as it would, to a certain degree, allow enamel to flow out and would prevent brush marks.

Tests indicate that the solvent power of this sample is equal, if not superior, to that of turpentine. In the case of rosin, limed rosins, ester gums and kauri, satisfactory solutions were obtained with this product alone and it was observed that it greatly aided mineral spirits as a solvent for these gums, as well as for short oil hard resin varnishes.

When used alone it will dissolve pale Damar, giving a clear, non-cloudy solution. The cloudy, semi-precipitated condition obtained when mineral spirits are used with Damar can be obviated by the use of this product in conjunction with mineral spirits.

The souring, or curdling of the poorer grades of Japan colors when reduced with mineral spirits, can be obviated entirely by its use, either separately or in conjunction with mineral spirits.

It has a distinctive pine odor, while turpentine has a mild pine odor. It should offer no disadvantage on this score for use in paints and varnishes. Owing to the low moisture content, which is less than one per cent, this product can be used in practically all proportions, without any cloudiness from precipitation of water. The color is the same as turpentine, water-white. Odor: not objectionable; reaction: neutral; evaporation (on filter paper): complete; sulphur, by white lead test: none. Price: substitute, 70 cents per gal.; turps, $1.23 per gal.

[This part of the report was signed by the chairman of the committee, Theo. Himburg. A short paper on the same subject, not given here, was presented by C. F. Mayer.—EDITOR.]

Combination Reducing Oils as a Substitute for Linseed Oil

Three papers were included in this part of the report, each setting forth the results of tests made by one of the members of the committee.

Paper by C. F. Mayer

Four substitute oils were tried out by practical tests for such purposes as freight car paint, caboose car paint, interior of baggage cars, and other miscellaneous work on which we are using boiled linseed oil. These products are simply reducing or thinning oils, whereas these products are offered and placed on the market to replace linseed oil for all pur-

poses in the mixing of paint, with equal if not better results than obtainable by the use of linseed oil.

These substitute oils mix readily with linseed oil, turpentine and Japan and show no signs of curdle or separation. They also hold in suspension the pigments equally as well as those mixed with boiled linseed oil. I have also found that the covering and working qualities of paint mixed with them are equally as good as those mixed with boiled linseed oil. It is our custom to add a small quantity of Japan dryer to our paints mixed with boiled linseed oil, and I find that paint mixed with these substitute oils dries as well, without adding dryer, as the paint mixed with boiled linseed oil and dryer. Some of these oils, however, are a little darker in color than boiled linseed oil, and where white or light colors are used they show a little discoloration, which might be objected to where light colors are used.

I prepared 10 wooden panels, two each of which are done with the substitute oils and two done with boiled linseed oil. On one set of panels the pigment is white lead, ground in oil, and on the other set of panels Venetian red, ground in oil. The colors were carefully mixed, and the same amount of pigment and oil was used in each one, and the color applied with separate brushes. The panels were placed on the south side of our paint stockroom at an angle of about 45 deg. The panels were placed out for exposure test March 4, 1921, and taken in July 31, 1923, making an exposure of about 28 months.

The panels on which white lead was used as a pigment show signs of cracking and breaking down. Those on which Venetian red was used as a pigment are in much better condition and show no signs of cracking or breaking down. Upon close examination, the panels done with boiled linseed oil have a trifle more life and are in better condition than those done with the substitute oils.

We have all had occasion to test a great many substitutes of various kinds. A great many of these are obsolete at the present time and nothing more is heard of them. From my tests with these linseed oil substitutes, a great improvement has been made, and the time is fast approaching when there will be suitable substitutes for linseed oil in the painting industry.

Owing to the exorbitant prices, and the claim that there is a shortage of linseed oil, it is the duty of every foreman painter to make tests with linseed oil substitutes, to prove to his own satisfaction that equally as good if not better results are obtainable by the use of substitutes, at a less cost to the railway he is serving. He should, however, not stop at this, but should conduct consecutive tests in order to be sure that the same product is being furnished as originally offered.

Paper by H. C. Allehoff

In January 1921 samples of substitutes for linseed oil were sent to me with request to make tests. Sample panels were painted with two coats, white lead, box car red and carbon black. These panels have been exposed since February, 1921.

While mixing these oils with the pigments, I found them to mix equally, the time of amalgamation being the same. When mixed, they disclosed a slight variation in colors. The table shows the difference in shade, the lowest per cent showing the lightest in color.

After painting on glass and allowing three hours to set, I found the suspension equal, excepting No. 5, which separated and resembled frosted glass, on the box car red only. The white and black remained in suspension.

I found the drying of the substitutes much better than the linseed oil. The table will show the per cent of variation in exact drying time.

I tested the clear oils for buoyancy by placing teaspoonfuls on pieces of glass. The table shows the number of inches or fractions thereof that each one flowed. For the buoyancy when mixed and standing for 12 hours, showing the amount of liquid floating, by separation, see Column G of the table.

After 90 days' exposure, painted on glass, I tested the elasticity of the film by scratching it with a knife. I found the substitutes very hard and brittle, whereas the linseed oil would cut off in long elastic films. The table will show the per cent of difference.

On the test panels, after 90 days' exposure, I found the substitutes receding in gloss. The chart will show the per cent of variation at the end of 90 days.

As to the combination of reducing oils and the amount of linseed that should be added, in order to prolong life or add to the wearing qualities, this is a matter of judgment depending entirely on the weight of the reducing oil. A light oil will give better wear by adding 50 per cent of linseed, whereas, a heavy reducing oil would only require 25 per cent in order to make it as serviceable as the other with 50 per cent. I have noticed from practical experience, when using a reducing oil thin in body, that it requires so much pigment in mixing to the right consistency for painting, that when dry it will only show a dull, silky gloss. By adding 25 per cent linseed, a good semi-gloss will be obtained, and by adding 50 per cent of linseed, it will resemble a linseed oil painted surface.

Paper by J. McCarty

I have tested out three grades of substitute turpentine that are now in use to a considerable extent. Two are of a petroleum product, especially refined and free from grease. When used in Japan colors the evaporation and flattening-out is much slower than pure turpentine, their solvent power varies considerably when coming in contact with some of the various makes of Japans and an immediate souring takes place when mixing with varnish materials. These substitutes are not of much value in railway equipment painting.

Comparative Test Data for Linseed Oil and Several Substitutes

Identification No.	Oil wt. per gal.	Amount of pigment red	Amount of oil red	Carbon blk. pigment	Carbon blk. oil	White lead pigment	White lead oil	A Suspension	B Shade	C Drying, hr.	D Buoyancy, in.	E Luster or gloss	F Elasticity	G Buoyancy, mixed	H Estimated valuation, 5-21
1	7½	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	100	24-36	3 in.	100	100	1/32 in	100
2	7½	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	100	14-24	4 in.	96	100	1/32 in.	100
1-A	7¼	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	98	8-14	7 in.	100	70	¼ in.	75
2-A	7¼	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	98	8-14	7 in.	96	70	¼ in.	75
3	7½	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	100	14-24	4 in.	110	110	1/32 in.	125
4	7	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.	O.K.	99	8-14	6½ in.	96	90	1/16 in.	75
5	7¼	1 lb.	½ pt.	½ lb.	½ pt.	1 lb.	¼ pt.		100	8-14	6½ in.	98	90	¼ in.	75

Note:—No. 1 is raw linseed; No. 2, boiled linseed; Nos. 1-A and 2-A a substitute oil, raw and boiled, respectively; No. 3, raw linseed oil, 1 gal., and 1 lb. litharge, heated until amalgamated; Nos. 4 and 5, substitute oils.
Column B—Test for color by placing between two glasses, allowing 1 per cent per shade difference in decrease of light.
Column C—1-A, 2-A, 4 and 5, set up in 8 hours, dry in 14 hours; 2 and 3 surface dry 14 hours, dry 24 hours; Nos. 1 and 3, 6 hours.
Column G—Amount of liquid flowing after standing twelve hours.
Column H—Estimated valuation two coats allowing four years' exposure.

One other turpentine substitute which is more expensive than the petroleum products but much lower in price than pure turpentine, is solvent in all grinding Japans and varnish materials, and does not show any signs of souring when coming in contact with varnish or enamel. When mixing with Japan colors the evaporation and flattening-out is about the same as pure turpentine. This substitute is taking the place of pure turpentine for all classes of work and general use at the present time in all paint materials at our shop.

In making tests of the substitute linseed oil samples sent to me I had sample boards painted with a mineral paint, ground to semi-paste with pure linseed oil and thinned with each of these sample oils, painted three coats and exposed to the weather for 14 months on the south side of our paint stock building at an angle of about 45 deg.

A chemical test of these oils shows the following results*:

	1-A	2-A	4
Volatile	53.6 per cent	54.4 per cent	46.3 per cent
Time of drying at 100 deg. F.	5 hrs.	2½ hrs.	1½ hrs.
Water test—whitening	none	none	none
Film	tough	tough	tough

There is a considerable variation in the percentage of volatile matter (benzine); sample No. 4 contains considerably less than the others. There was also a good deal of difference in the time of drying. Sample No. 1-A is much lower than the others. This drying test was made at a temperature of 100 deg. F. in order to make duplicate tests at any time of the year. In practice when exposed at ordinary shop temperature the time of drying would be over double that found at a temperature of 100 deg. F.

These samples all appear to be composed of China wood oil or a similar base, and all are resistant to water. A good deal of the value of this oil material in preserving wood would depend upon the thickness of the paint film, and consequently the results in service would not be likely to be so durable as though a paint composed of pure linseed oil were used. The sample panels that were exposed to 14 months' weather test show up well and the durability of these oils and the linseed oil are about the same. In pressing the paints between two pieces of glass no difference of shade in color was noticeable. In flowing out a sample on glass the substitute oils show more weight in body than linseed oil.

TIME OF DRYING ON GLASS AFTER FLOATING

	Hours to dry to bottom
Sample No. 4	6
No. 5	20
No. 2-A	14
No. 1-A	20
Boiled linseed oil	24

Precipitation in mineral paints takes place more readily with the No. 5, No. 1-A and No. 2-A oils than with linseed oil. The No. 4 sample holds the paint in suspension equally as good as linseed oil. These paints were put in glass jars, sealed and let stand for 12 months. When opening the oil and No. 4 oil mixture the oil was floating on top but mixed up readily. The samples mixed up with No. 5 oil and the No. 1-A and No. 2-A oils were precipitated solid in the bottom.

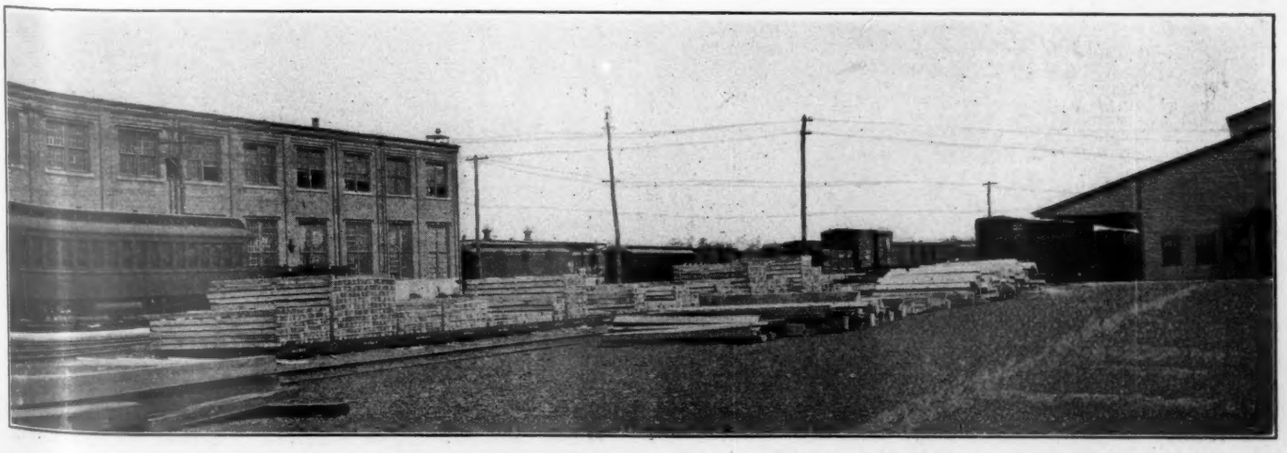
*These samples are of the same materials as those referred to in Mr. Allehoff's paper, which bear the same numbers.

Discussion

The discussion of this report dealt principally with the necessity for practical tests to determine the physical characteristics of paint materials to supplement the chemical tests. One case was cited in which a substitute for turpentine had been pronounced satisfactory for universal use on the basis of the results of a chemical analysis, which would not dry when used as a paint material. After standing several hours, an appreciable amount of paraffin had separated at the top, and rubbing the finger over the painted surface caused a change of color. The importance of finding suitable substitutes for turpentine and linseed oil were also touched upon, as only in this way can the cost of these materials be kept at a reasonable figure. Not all substitutes are satisfactory, however. Some substitute materials have been found to be dangerous to use, causing soreness of the hands and faces of the painters handling them.

Relation of Draft Gear Capacity to Rough Handling

THE study of the rough handling of cars made by the Freight Claim Division of the American Railway Association shows that speed is the principal contributing factor, followed closely by draft gear capacity. It has been found that when cars collide, the forces between them increase at a much greater rate than the velocities. Tests made by the Inspection and Test Section of the United States Railroad Administration and data of the Norfolk & Western on two 40-ton cars equipped with draft gears which close at an impact velocity of two miles per hour, show that when the cars traveled at 1 mile per hour, the reaction forces amounted to 20,000 lb.; at 1½ miles per hour, 40,000 lb.; at 2 miles per hour, the impact velocity at which the gears close, 70,000 lb., and at 2½ miles per hour, 630,000 lb. This shows that after the gears close, an increase of only ½ mile per hour, or 25 per cent in speed, resulted in an increase in the reaction forces of 560,000 lb., or 800 per cent. Another test, using two 57½-ton cars equipped with draft gears closing at a speed of 4 miles per hour, showed that at 4 miles per hour the reaction forces were 370,000 lb., and at 4½ miles per hour, 1,140,000 lb. In this case with an increase of ½ mile per hour, or 12½ per cent in speed, there was an increase of 770,000 lb., or 208 per cent in reaction forces, and that after the draft gears go solid they no longer serve their purpose.



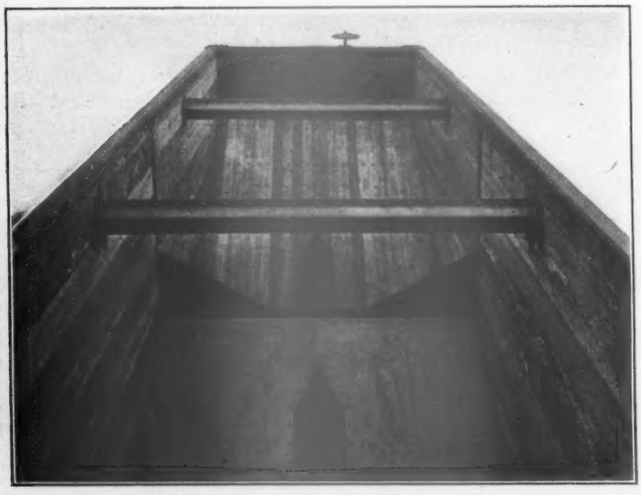
Orderly Arrangement of Lumber Piled by Sizes Between Modern Car Shop and Dry Kiln

Composite Hopper Car Built for the New York, Chicago & St. Louis by the Pressed Steel Car Company

Composite Hoppers for the Nickel Plate

Wooden Sides and Flooring Are Found to Be More Economical Than All Steel in Cost of Building and Maintenance

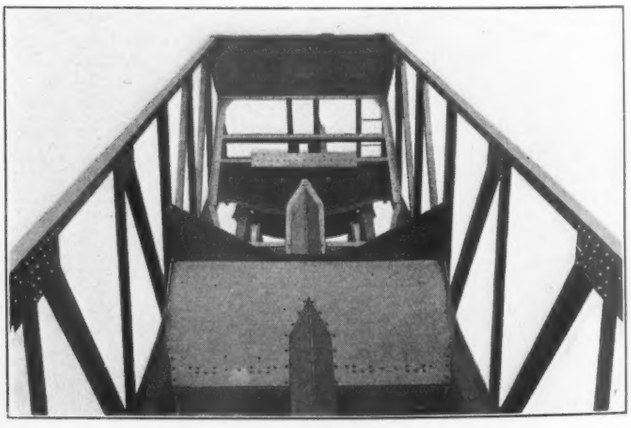
COMPOSITE hopper cars of unique design have just been completed for the New York, Chicago & St. Louis by the Pressed Steel Car Company, McKees Rocks, Pa. The entire construction of the cars, from the side sill down and including also the center sills, center sill cross ridge and the entire ends of the car, is the same as commonly used in the construction of all-steel hopper cars. The essential difference is the application of wooden sides and flooring to the steel frame. The superstructure consists of an all-steel frame to which planks for side wall and flooring have been bolted.



Interior View of the Completed Car

Replacement of the wooden sides and flooring with steel can be readily accomplished without otherwise making any changes in the car, except, possibly, the removal and replacement of some of the rivets through the framing. To avoid corrosion as far as possible, copper-bearing steel is used for all sheets exposed to coal loading.

The original design was developed in 1916, at the request of J. J. Bernet, president N. Y. C. & St. L., to avoid the use of steel as far as possible on account of the high price and scarcity of steel that prevailed at that time and having in



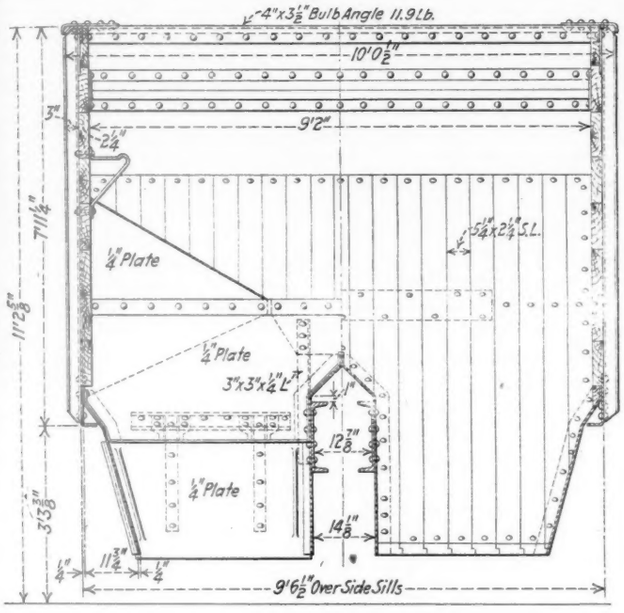
Interior View of the Car Before Wooden Flooring and Side Walls Are Applied

mind also the heavy maintenance of all-steel cars due to corrosion. During the five years that the original cars have been in use, the maintenance has consisted chiefly of repainting the steel parts.

Changes From Original Design

There were 750 cars built according to the original design. These cars have given satisfactory service to the railroad company for over five years, and there were very few changes in working up the design for the new cars. The only im-

portant changes made were increases in the length and height to obtain greater cubic capacity. The inside length was increased from 30 ft. to 33 ft. 8 in., and the height from the bottom of the side sill to the top side angle was increased from 7 ft. 3¼ in. to 7 ft. 11¼ in. Friction draft gears were applied to conform to recommendations of the American Railway Association and some slight reinforcements of center sills and body to compensate for the increase in length were



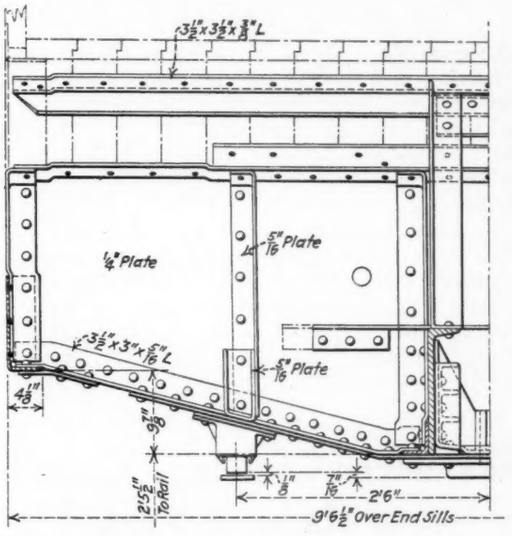
Cross Section of Nickel Plate Composite Hopper Car

also made. The distance between the truck centers was increased from 21 ft. 9 in. to 24 ft. 9 in., which increased the total distance over the striking plates from 31 ft. 11½ in. to 35 ft. 7½ in. The design of the truck side frames was changed also to conform to present practice. These changes effected an increase of 390 cu. ft. and 19,800 lb. in the capacity of the car, when loaded with soft coal.

Underframing

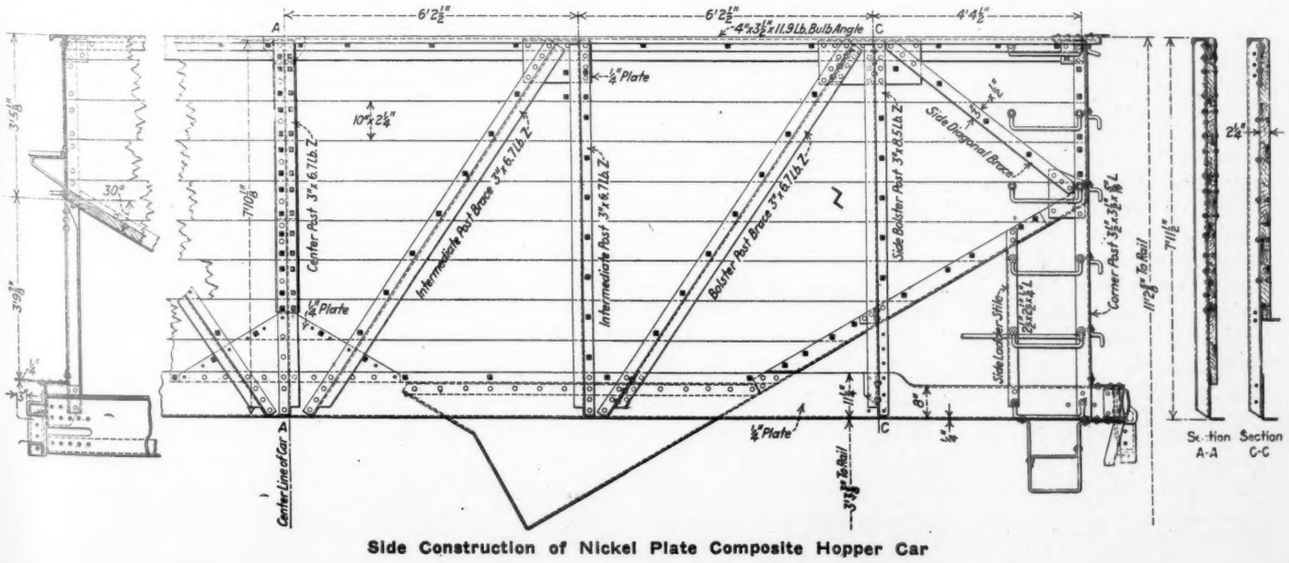
The center sills consist of two 15-in., 55-lb. channels, 34 ft. 8¼ in. long, spaced 12⅞ in. apart for their entire length. No cover plate is applied, but reinforcement is obtained by means of three corrugated pressed steel stiffeners, two 2 ft. 4¼ in. from the center line of the body bolster and one at the center of the car, respectively, and also at the bottom by 4-in. by ⅜-in. by ⅜-in. angles which extend from the outward end of the center sill 50⅞ in. beyond the center line of the body bolster to the slope sheet of the hopper. This bottom angle overlaps the application of the hopper inside sheet and the center sill cover so that the center sill is considered as reinforced to an extent approximately equal to that of a top cover plate. The cross-section of center sills, not including the bottom reinforcing angles, is 32.36 sq. in.

The end sills are made of 8-in., 11½-lb. channels fastened to the side sills with 3½-in. by 3½-in. by 5/16-in. angles. They are reinforced by diagonal braces of 5-in. by 3-in. by 5/16-in. angle section, extending from the outside corners to a 5/16-in. angle section, extending from the outside corners to a 5/16-in. cover plate connecting the body bolster and draft sills. The side sills consist of ¼-in. plate, flanged at the bottom, with 11¾-in. vertical sides, to which the side posts and side post braces are riveted. The hopper and the



Section at the Bolster of Nickel Plate Composite Hopper Car

floor framing are riveted directly to the side sills and center sills, thus giving the necessary stiffness. The body bolsters consist of ¼-in. plate reinforced at the bottom, center sills, intermediate section and side sills by 3½-in. by 3-in. by 5/16-in. angles and by ½-in. top and bottom cover plates. The center plate casting is riveted directly through the center sill channels to the bolster.



Side Construction of Nickel Plate Composite Hopper Car

Side Framing

The sides are built of 2¼-in. by 10-in. shiplap siding bolted to a framework of 3 in., 6.7-lb. Z-bars, except the Z-bar at the ends of the bolster, which is 8.5 lb. In order to facilitate interchangeability from wood to steel, the side planks are cut to reach from the end to the center of the center side post. A ¼-in. copper bearing steel plate is used as a splice and extends from the top side bulb angle down to the cross ridge gusset. The measurement, from the bottom of the side sill to the top of the top angle, is 7 ft. 11¼ in. and the total height from the top of the rail is 11 ft. 2⅝ in. These measurements are 6⅝ in. above that of the U. S. R. A. standard hopper cars of all-steel construction. Each of the side posts is riveted directly to the side sill and braced as shown in the drawing. The corner post is a 3½-in. by 3½-in. by 5/16-in. angle, to which the siding is bolted. The end sheets are steel and riveted to the corner posts. The top side angle is a 4-in. by 3½-in. bulb angle, commonly used on all-steel cars.

Flooring

The same size shiplap used for the sides is also used for the flooring and is bolted to the frame in much the same manner as an all-steel floor would be riveted. The hoppers and hopper doors are constructed of copper-bearing steel to prevent corrosion. With the single exception that the sides and flooring are of wood, the general interior appearance is the same as any ordinary hopper car.

The trucks have box section, cast steel bolsters and cast steel side frames with the journal boxes cast integral with the frame. The stencilled capacity of the car is 110,000 lb. The light weight averages about 42,300 lb., which compares favorably with an all-steel hopper car of equivalent strength and cubic capacity. The cubic capacity of the new cars is 2,050 cu. ft. level full and 2,295 cu. ft. with a 10-in. heap.

The Pullman Company's Contribution to Railroad Safety*

By E. F. Carry
President, Pullman Company

THE Pioneer, the first Pullman car constructed from the ground up by Mr. Pullman, in 1865, was fittingly named. It marked with its monitor roof and general sturdiness a tremendous advance in the art of car building, and was truly a pioneer in so far as strength, safety and solidity in passenger car construction was concerned.

The record of Pullman achievement in improvement and development of railroad equipment is one of constant progression. Probably the Pullman vestibule would be accorded premier position by railroad men the world over as the device which has done more than any other to render railway travel safe. Communication between cars in a train at high speed would be perilous were it not for this vestibule. It not only renders passage from car to car secure and protects passengers from exposure, but it provides to a marked extent a bulwark against serious damage to the body of the car and its occupants from the lighter shocks and wrecks. The enclosed vestibule of today is a development of the narrow vestibule brought out in 1887, and since its introduction in 1893 has become the universal standard for all important trains.

The Six-Wheel Truck a Contribution to Safe Travel

Another important Pullman development for the heavier passenger train cars is the six-wheel truck with its long wheel base. Its excellent general arrangement and fine riding qualities contribute greatly to comfortable travel. The excellency of this truck design has led to its general adoption for heavy passenger equipment cars. Its contribution to safety, particularly in high speed service in our heaviest train, lies in the fact that with six wheels a journal broken or burnt off in service will not necessarily cause a wreck, while with a four wheel truck disaster practically would be unavoidable.

Other Mechanical Developments in Pullman Car Safety

Early recognizing the importance of providing a bulwark against collisions (in addition to the enclosed vestibules), special protective features, generally designated as anti-telescoping devices, were first introduced in Pullman cars. These devices consisted of steel introduced at the sills, in the ends, and at the top of the vestibule. To the extent to which such devices are capable of absorbing energy by resistance to distortion and rupture, they afford collision protection to the car, and the use of extra metal for this purpose has become general in the construction of passenger equipment.

Among other noteworthy improvements developed or adopted for use on Pullman equipment in recent years there may be listed:

Locking bolts for connecting trucks to bodies as an anti-telescoping feature.

New truck design which permits of greater ease of inspection and with its pivoted and boxed in equalizers is a safeguard against the possibility of wreck due to a broken equalizer.

Development and adoption of a practical application of the new A. R. A. standard Type D freight coupler for passenger cars and correspondingly strong draft gear attachment to prevent the breaking in two of long trains and the breakage of coupler knuckles occasionally experienced with ordinary couplers.

Improved generator suspension to insure against the possibility of wrecks due to the loosening and dropping of generators.

The improved step box, with a larger surface area and without the hand-hole on the top of the box in which small French heels are sometimes caught.

The anti-pinch device on car doors to prevent fingers getting caught between the door and door jamb.

Guard rails on the hallway windows.

The floor lights in the aisle at night when the major lighting system has been turned off.

Berth locking device to prevent the upper berth folding up unexpectedly. Safety step ladder to be used in ascending to and descending from the upper berth.

Curtain guards for upper berths to prevent the occupant rolling out.

Inside vestibule grab handle to steady the passage from car to car.

Vestibule roller curtains, to prevent people catching their fingers between diaphragm and face plates.

Improved hinged buffer plate, to prevent feet being caught between the end sill and the buffer. This plate also presents a smooth surface and eliminates tripping hazards.

Vestibule ceiling lamp over the trap door. This not only provides illumination during transit from car to car, but also guides the footsteps when entering and leaving the car.

Pullman equipment is constantly scrutinized and all suggestions affecting the safety or comfort of passengers receive careful consideration. Inventive geniuses in car equipment all over the country regard Pullman approval as a mark of merit and gladly afford the Pullman Company a chance to investigate and try out new devices. Our own chemical and physical laboratories are constantly engaged on the work of research, investigation, examination, and check on materials, and an inspection force is everlastingly on the job. They examine materials, they keep an eye on equipment and watch service.

*Part of a paper read before the meeting of the Steam Railroad Section of the National Safety Council, held at Buffalo, N. Y., October 2, 3 and 4.

Ventilation Studies for Passenger Health

Among the important contributions of the Pullman Company to the hygiene of railway travel are its studies in car ventilation, which began in 1905. When our study of this subject was begun the science of ventilation was just emerging from the dark ages of misconception and error, and rays from the light of exact knowledge were just beginning to touch it. The sun is fully up now, and it enables us to see how important are heat and heating facilities in connection with air supplies. Indeed, it has shown us the proper control of heat is a more important hygienic problem, and a rather more difficult one, than the maintenance of a proper supply of air. This has led us to multiply our heat units and controls for a car from one to seven. That also makes for health.

The blow fan is an important adjunct to the maintenance of good air conditions which was first introduced into railway service by the Pullman Company. And the small louvre mounted in the window sash, which may be opened and closed by the passenger according to his desire, is a recent innovation which is worthy of a place in this list.

Pure Water Facilities on Pullman Cars

Of almost equal importance with air is the water supply of a car. It *must* be supplied for drinking, and its availability for the purposes of toilet and cleaning adds to comfort and healthful conditions. In recent years, the United States Public Health Service, in co-operation with state and city boards of health, has taken over the task of seeing to it that the waters supplied by common carriers are of proper standard of purity; they must all be examined and certified at regular intervals. And it is fair to say that they are practically all and always safe now as delivered to the car.

But there are sources of possible contamination after the water is safely aboard—the cooler; ice that goes into it; and worst of all, its final container, the cup. In 1912 we began dividing water coolers into two compartments so that ice and water would be kept separate. But this left the cooler open for the possible entry of foreign materials, so in 1920 we developed a method of doing away with the open cooler entirely, substituting for it a cooling chamber which is part of the pressure system about which the ice is packed—undoubtedly the best and safest plan that has ever been put into use. The common drinking cup was universally abolished and the individual paper cup substituted about 10 years ago.

Lest we be too generous with ourselves in the appropriation of laurels, let it be admitted at once that dividing the water cooler and abolishing the common cup were not original conceptions. They were first demanded by the state health officer of Kansas. But once the demand was made, the idea was accepted by the Pullman Company and costly improvements were made universal that were only locally necessary. And the common towel was unknown in Pullman cars long before it became the object of the official taboo in any of the states.

There are many minor sanitary features of Pullman equipment and service that would be worthy of being classed as contributions to the safety of travel in a more extended discourse—plumbing and toilet arrangements, the care and handling of linen, fumigation and disinfection, the encasing of beds and bedding, first aid packets on cars, and others—but they may be only mentioned here. Particular claims may be made, however, for the dental lavatory, adopted in 1909, and the open-front toilet seat, adopted five years ago.

The Standard Railway Sanitary Code

In 1905 the Pullman Company established, and has since maintained, the first department of sanitation conducted by any common carrier in this country. Through this department it has kept in close touch with sanitary progress in general and with railway sanitation in particular. One of the things we have had to contend with is a great diversity of sanitary laws and regulations in the states, which have sometimes been contradictory, often inharmonious, and occasionally entirely impractical or absurd. Partly through the efforts of our department of sanitation there has been developed in the last few years a Standard Railway Sanitary Code, covering all the important features of safeguarding the health of railway travelers, as a proposed substitute for the diverse state and national laws and regulations which went before it. This has now been adopted by 31 of the states, and the interstate regulations have been so revised as to be entirely harmonious with it, so that uniformity of public requirements is fast replacing the former chaos. In so far as we have contributed to the formation and the introduction of this code—and that is materially—we have contributed not only to the safeguards of health in railway travel, but to the peace of the railways as well.

Recent Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Owner Responsible for Defects Resulting from Long Usage

On January 17, 1921, the Union Refrigerator Transit refrigerator car No. 3806 underwent repairs at the Corbin, Ky., shops of the Louisville & Nashville, which involved the renewal and repair of the center sills, cross tie members, part of the flooring and one intermediate sill. Charges for repairs made to this car were included in the Louisville & Nashville bill for August, 1921, to the amount of $352.88 against the Union Refrigerator Transit Company, the total cost of repairs to this car being $216.01.

Exceptions were taken to the entire charge for repairs made to this car by the Transit company, claiming that in order to bring about this damage the car evidently met with unfair usage. The Louisville & Nashville claimed that after a thorough investigation of the movements in the handling of this car over its rails, it was found that the car met with no unfair usage as defined in Rule 32 and that all repairs were necessitated by ordinary wear and tear for which a car owner is responsible.

It was decided by the Arbitration Committee that "the evidence submitted does not warrant the claim that the defects in question were the result of any of the conditions enumerated under Rule 32. Therefore, owner is responsible."—*Case No.* 1262, *Louisville & Nashville vs. Union Refrigerator Transit Company.*

Repairing Line's Judgment Sustained as to Needed Repairs

The A. E. Staley Manufacturing Company's tank car No. 25 underwent repairs, on account of decayed running boards, at the Trans-Mississippi Terminal Railroad shops at Goulds-boro, La. The A. E. Staley Manufacturing Company refused to pay the bill for these repairs. It was claimed that the car in question had been inspected by the owner's inspector at Decatur, Ill., before the car had left that point and it was found to be in good condition. The car went through two interchanges at Decatur, Ill. On June 2, 1922, it was set back on the Illinois Central interchange at New Orleans and the Trans-Mississippi Terminal shopped it to its Goulds-

boro, La., repair track. The owner contended that the car should not have been accepted from the Illinois Central until after repairs had been made. The Trans-Mississippi Terminal claimed that these repairs were made in good faith in accordance with the A. R. A. Rules and the United States Safety Appliance requirements. Its records show that "the running board was decayed and necessitated renewal and the expense was properly charged to the car owner."

The Arbitration Committee decided that "no evidence had been submitted to prove that the contention of the repairing line is incorrect. Therefore, bill against car owner is sustained."—*Case No.* 1263, *Trans-Mississippi Terminal Railroad vs. A. E. Staley Manufacturing Company.*

Another Case of Damage Due to Weak Construction

On April 11, 1922, the Wheeling & Lake Erie reported Green Bay & Western box car No. 2192 under M.C.B. Rule 120, enumerating certain defects of the body of the car, which it claimed was the result of switching cars in train No. 83 at Creston, April 10, 1922. The Green Bay & Western refused to handle this case under Rule 120, contending that the evidence pointed to unfair usage and asked that the handling line restore the car to serviceable condition at its own expense. The evidence submitted in this case was similar to that in Case 1261, Lehigh Valley vs. Pere Marquette, which was reviewed in the October number of the *Railway Mechanical Engineer.*

The Arbitration Committee rendered practically the same decision and decided that there was no evidence of the car having been subjected to any of the unfair usage referred to in Rule 32. Car owner is responsible.—*Case No.* 1264, *Green Bay & Western vs. Wheeling & Lake Erie.*

Owner's Defects Associated With Unfair Usage Defects

The Chicago, Rock Island & Pacific at its Blue Island shops on August 31, 1921, repaired St. L., B. & M. car No. 2011, which is the property of the Gulf Coast Lines. The repair bill included a number of items, part of which were caused by the car being cornered in terminal movement on the Rock Island lines. When the car was sent to the shops for repairs, it was found to be in generally bad order and additional repairs to various parts of the car were found necessary. In accordance with the provisions of Rule 41, the Rock Island separated the owner's defects from the delivering line defects and the owner was not billed for the items of repairs necessary on account of unfair usage. The Gulf Coast Lines maintained that inasmuch as this was a car having a steel underframe and superstructure, that it would not be likely to break out at the ends and in its opinion, the damage was the result of the car being cornered, and that the entire charge should be cancelled.

The Arbitration Committee decided that "in view of the assurance of the Chicago, Rock Island and Pacific that the defects caused by cornering were marked 'no bill' and that the other defects were owner's responsibility under Rule 41, in the absence of evidence to the contrary, the charge of the Chicago, Rock Island & Pacific should be accepted."—*Case No* 1265, *Gulf Coast Lines vs. Chicago, Rock Island & Pacific.*

Non-Interested Line Delivers Defective Car to Owner

The Rio Grande & Eagle Pass was notified by the Gulf Coast Lines that R. G. & E. P. car No. 313 was in its yard at Robstown, Tex., in a damaged condition, and requested joint inspection to be made, as the Texas Mexican Railway refused to accept the car. This was agreed to, with the proviso that upon receipt of the joint evidence certificate by the Rio Grande & Eagle Pass, it would advise disposition of the car. Without waiting for instructions from the owner, the Texas Mexican received the car from the Gulf Coast Lines and delivered it to the owner at Laredo, Tex. Joint inspection had been made at Robstown by the inspectors of the Gulf Coast Lines and the Texas Mexican. A second inspection was made at Laredo by the inspectors of the Texas Mexican and the Rio Grande & Eagle Pass, and this inspection showed additional defects not shown on the joint evidence certificate resulting from the inspection at Robstown.

The car owner contended that the nature of the defects indicated the damage was due to unfair usage, and a bill covering the repairs to this car was presented to the Texas Mexican which refused payment. The Texas Mexican claimed that responsibility for these damages should be placed with the Gulf Coast Lines. Evidence of the interest of the Gulf Coast Lines in this case was shown by a letter from that railroad to the secretary of the association. The Texas Mexican pleaded "not interested."

The Arbitration Committee decided that no evidence had been submitted in support of the owner's contention that the car must have been damaged by unfair usage. The car owner is responsible.—*Case No. 1,266, Rio Grande & Eagle Pass vs. Texas Mexican.*

Another Case Where Rule 32 Does Not Apply

On May 12, the Seaboard Air Line reported A. B. & A. car No. 10110 for disposition under Rule 10. The car was in a train of 61 cars that were being switched in the Portsmouth, Va., train yard of the Seaboard Air Line. The train was moving at about three or four miles an hour when the brake pipe pressure dropped suddenly and stopped the train. This car, a wooden frame flat car, broke in two in the middle and the coupler on Northern Pacific flat car No. 68457 was also broken. This was the only damage sustained by any of the equipment in the train. In a letter from the Seaboard Air Line reporting the accident it was also stated that neither this car nor any other car in the train had been sideswiped, cornered or derailed. The Atlanta, Birmingham & Atlantic was not satisfied with the statements from the Seaboard that the car was not damaged under the provisions of Rule 32, and it took exception to this statement, claiming that the car was damaged on account of the sudden reduction of air pressure; also that handling a train of 61 cars with the air brakes operating on about 18 or 20 cars constituted unfair usage.

It was the decision of the Arbitration Committee that the evidence furnished did not show that damage occurred under any of the conditions of Rule 32. Therefore, the car owner was responsible under Rule 43 and should furnish disposition per Rule 120.—*Case No.* 1267, *Seaboard Air Line vs. Atlanta, Birmingham & Atlantic.*

Prices in Effect on Date of Repairs to Govern Charges Under Rule 120

Seaboard Air Line Box cars No. 16464, 17676, 18240 and 18741 were set aside at the Rutherford, Pa., car shops of the Philadelphia & Reading in accordance with United States Railroad Administration Division of Operations Circular No. 20, and the recommendation that they be dismantled was submitted to the regional director on the prescribed form. On March 31, 1920, after the end of Federal control when Circular No. 20 was modified, these cars were reported to the owner for disposition under Rule 120. Inspection certificates dated December 19, 1919, were submitted with an estimate of $1,900.34 covering the total cost for general repairs to the four cars. This estimate did not include betterments or the percentage allowed under Rule 106.

The Seaboard Air Line authorized that these cars be repaired, with betterments, under date of April 23, 1920. The Reading, although admitting that it was obliged to repair these cars, contended that they should be dismantled owing

to their age and worn out condition, and set forth that its shop situation was such that they could not be rebuilt with any degree of promptness. The Seaboard Air Line claimed that the Reading arbitrarily delayed repairs approximately a year and a half; also, that the cost of these repairs should not exceed the total estimate, plus $50 per car and betterments, and 30 per cent, under Rule 106, added to the total. On this basis, the owner estimated that the total cost of repairing the four cars, at the time of authorization, should have been $3,567.41. The repairing line contended that the bill, based on the rules in effect on the date the repairs were made, should be accepted.

The Arbitration Committee decided that the prices in effect on the date the repairs were completed should govern.—*Case No.* 1268, *Seaboard Air Line vs. Philadelphia & Reading.*

Labor Allowance for Applying Draft Gear Bolts

The labor allowances contained in Rule 107 of the 1921 Code omit a specific charge for the application of yoke bolts. The St. Louis-San Francisco billed the Missouri, Kansas & Texas one hour for this operation as formerly allowed for several years under this rule. The owner declined to accept the charge of one hour, claiming that it should be reduced to .4 hours as per Item 91 of the 1921 Code. After the exchange of several letters, Supplement No. 2 was issued allowing .6 hours for this operation. The St. Louis-San Francisco then reduced their charge to .6 hours. The Missouri, Kansas & Texas still declined to accept the reduced charge on yoke bolts applied prior to the issuance of Supplement No. 2, contending that the labor allowance should be reduced to .4 hours.

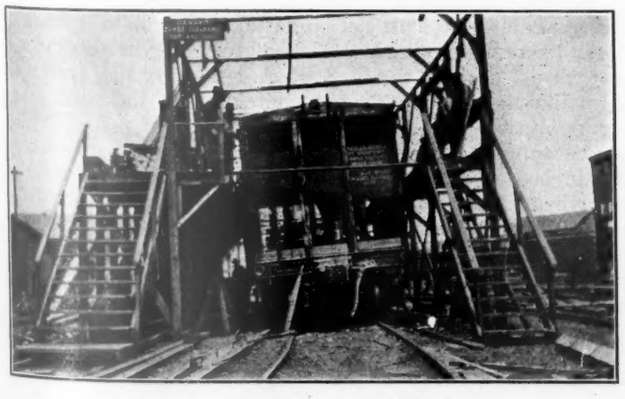
The Arbitration Committee sustained the objection of the Misouri, Kansas & Texas, stating that Item 91, Rule 107, applies to repairs made prior to July 1, 1922, in the absence of a specific allowance for the bolts in question—*Case No. 1,269 St. Louis-San Francisco vs. Missouri Kansas & Texas.*

Repairing Freight Cars By Progressive Methods

By W. W. Warner

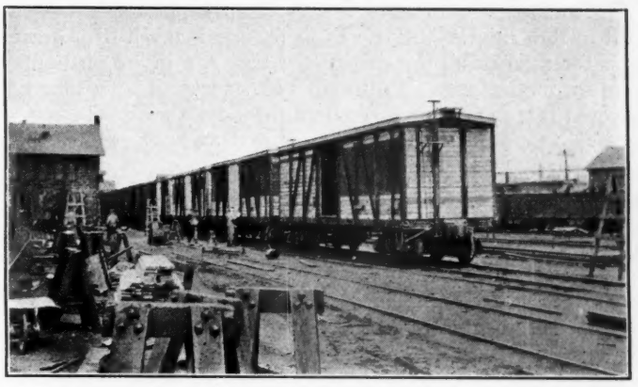
Works Manager, Youngstown Equipment Company

A PRACTICAL application of the "straight line" system in repairing steel frame box cars is being used in the Kent shops of the Youngstown Equipment Company. The cars are spotted at station No. 1, where a complete inspection is made, the defective parts marked and all defective wood work, old bolts, nails and broken parts removed from the car. All dope is removed from the journal boxes. This station is under the supervision of an assistant foreman, who performs the work with an inspector and eight carmen.



Permanent Scaffolds at Station No. 4

The car is then switched to station No. 2 where all the metal parts of the body are repaired or renewed by a gang consisting of an inspector and 30 carmen under an assistant foreman. They are then moved to station No. 3, on what is known as the "build-up" track. Here the work of applying the flooring, sheathing, roofing, doors and safety appliances is performed. Permanent scaffolds, shown in the illustration, with wide platforms are used for the roof gangs. The roofing material is piled on this scaffold within easy reach of the workman. Items of small material, such as bolts, nuts, washers, screws, etc., are placed in small bins where the workmen can reach them by simply turning around. These bins are kept supplied with material at all times by the material deliverers.



Cars Undergoing Repairs At Station Number 6.

The workmen at this station are divided into two gangs under an assistant foreman. Eighteen men are used to jack up and set the bodies on trestles, repair the trucks, pack journal boxes, apply and bolt the floor, perform the air brake work and jack the car down on the trucks. A gang of six men under the same assistant foreman, puts on the side doors and safety appliances.

The cars are moved along the "build-up" track to station No. 4 by means of a flexible wire rope attached to an air driven winch. This rope is equipped with "S" hooks every 50 ft. so that it can be hooked to any car on the track. At this station the roof purlines, ridge pole, facing, roof sheets, nailing strips, roof boards and running boards are applied. The work at stations No. 4 and 5 are under the direction of the same assistant foreman. Ten carmen are detailed to do the work at station No. 4. At station No. 5, the work of applying the side and end lining is taken care of by nine carmen.

After the work at station No. 6 has been completed, the cars are placed on the paint track, station No. 7, where three painters clean the exterior surface and apply the first and second coats. The painting is done with an air spray. Paint and other materials are delivered to the proper station by electric trucks. This method of delivery, on account of the large quantity of material used has effected considerable saving.

The work of stations No. 7 and 8 is under the supervision of the same assistant foreman. At station No. 8, one painter does the work of stencilling and an inspector employs part of his time in testing the air brakes and making the final inspection.

Air motors are used for all boring. Special screw drivers are used in air motors for driving screws in roofs and running boards. Socket wrenches are used in the same manner for tightening the ½-in. nuts on bolts that secure the side and end sheathing and the flooring. An air motor driven circular saw is used to cut off the roof boards.

A Mathematical Law of Impact Between Cars

A Study of the Time of Partial and Full Draft Gear Closures, Checked by U. S. R. A. Test Results

By E. M. Richards

THE function of a draft gear, as is well known, is to equalize velocities between adjacent cars without injury to the car structures. It is often supposed, however, that in thus minimizing shocks more time is taken by a draft gear for dissipating the energy of severe run-ins or pull-outs than for milder cases. Putting it another way, it is frequently believed that more time is required for a draft gear to be compressed to its full travel—the entire travel for which the

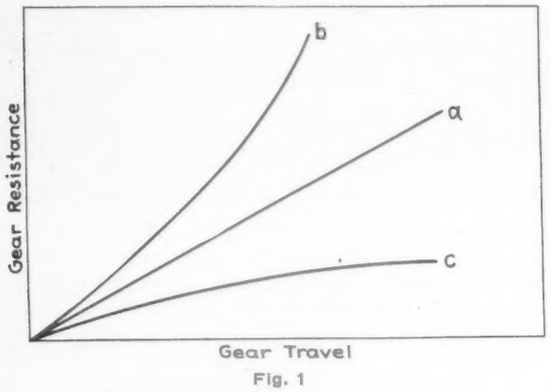


Fig. 1

gear is designed—by a given train action than for it to be forced through only a portion of that travel by a train action of lesser magnitude.

But the truth of the matter is that the time in each instance is substantially the same. In other words, for given gears in given cars, the maximum gear closure—not necessarily full gear travel—on each impact, whether it be ½ in., 1 in., 2 in. or full gear travel, takes practically the same length of time.

These latter statements, however, are subject to qualification,

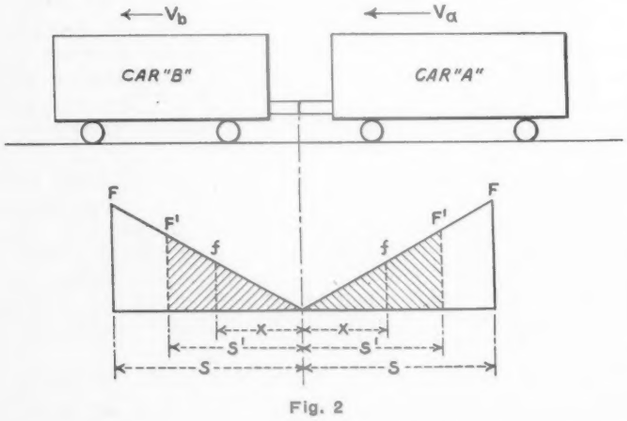


Fig. 2

because there is some variation in time, although not usually a great deal, depending upon the shape of the "gear resistance-gear travel" curve. If a straight line relation exists between gear resistance and gear travel, as shown by curve *a* in Fig. 1 and as usually assumed when a study of draft gear action is made, then the times are exactly the same. If the line bends upward, as shown by curve *b*, Fig. 1, then strange though it may appear at first thought, the farther a draft gear is driven inward on different impacts, the shorter the time of its compression travel, *i. e.*, the more severe train actions are dissipated in a briefer time than those of lesser degree. Only when the line bends downward, as in curve *c*, Fig. 1, does the gear perform as one would ordinarily expect, and take a longer time for its travel the farther it is driven in on different impacts.

The validity of these statements can be established from the report of the United States Railroad Administration draft gear tests,* with which tests the author was connected. Before going into these data, it should be borne in mind that, in addition to draft gear action, the figures of these tests must necessarily include the influence of car resistance, grade, the variation in the coefficient of friction with different rates of movement of the frictional elements at various degrees of impact and the fact that gears perform somewhat different every time they are operated. While academically exact figures cannot be expected, yet with all these outside influences, the test results, as will be seen, unquestionably establish the truth of these statements.

One more digression must be made before getting into the

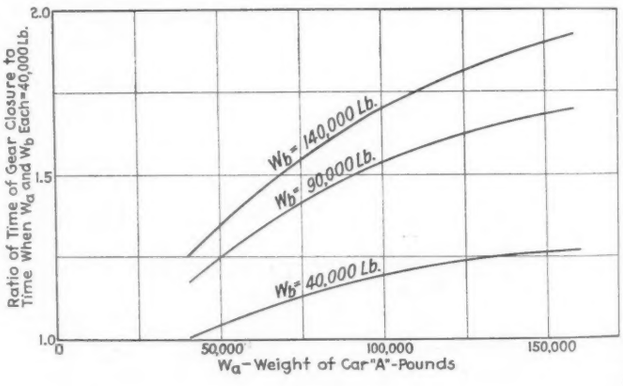


Fig. 3

question of time as shown by the tests. Reference is made in the present article to the "gear resistance-gear travel" curve. This curve must not be mistaken for the well known static diagram, for which the latter gives a "gear resistance-gear travel" relation, the U. S. R. A. tests show that it is not at all like the dynamic diagram developed by the same gear during impact in a car, either in size or general shape. This can be appreciated by comparing the static diagram of the Westinghouse NA-1 gear on page 45 of the test report with the dynamic diagram on page 172 and by similar comparisons of the Sessions K gear on pages 46 and 158, and the Cardwell G-25-A gear on pages 48 and 207. Not only are the general shapes entirely different, but the resistance values also. For instance, the Westinghouse NA-1 gear showed at 1½ in. travel on static test, 360,000 lb. and 490,000 lb. resistance and on the dynamic test, 60,000 lb. and 110,000 lb.; the Sessions K gear at 1½ in. travel on static test developed 290,000 lb. and 460,000 lb. and on dynamic test, 110,000 lb. and 160,000 lb.; the Cardwell G-25-A gear at 2 in. travel on static test developed 270,000 lb. and 300,000 lb. and on dynamic test, 60,000 lb. and 90,000 lb. Since it is the

*Published in book form in 1921, by the Simmons-Boardman Publishing Company. References in the article are to this book.

dynamic relation which obtains during impact, this is the relation considered in this article.

With the foregoing in mind, the times of maximum gear travel for different impacts for both partial and full gear closure, as taken from the U. S. R. A. tests and tabulated in

TABLE I—TIME OF PARTIAL AND COMPLETE GEAR CLOSURE

Compiled from Pages 122-127, U. S. R. A. Tests

Name of gear	Amount of draft gear closure, inches (Average of both gears)		Time of partial and complete closure, seconds	
	At 1 m.p.h. initial velocity difference	At initial velocity difference just sufficient to close gears. (Approximately 2 to 5 m.p.h.)	At 1 m.p.h. initial velocity difference.	At initial velocity difference just sufficient to close gears. (Approximately 2 to 5 m.p.h.)
National H-1	.63	2.53	.092	.091
Sessions K	.54	2.03	.075	.095
Miner A-18-S	.32	2.61	.065	.098
Westinghouse NA-1	.81	2.98	.143	.124
National M-1	.55	2.61	.092	.104
Sessions Jumba	.57	2.92	.097	.121
National M-4	.55	2.49	.093	.111
Cardwell G-18-A	.66	3.21	.119	.144
Cardwell G-25-A	.30	2.76	.072	.116
Westinghouse D-3	1.20	2.48	.173	.112
Gould 175	.82	2.48	.148	.114
Murray H-15	.66	2.60	.126	.127
Christy	.42	2.15	.063	.104
Miner A-2-S	.40	2.52	.074	.138
Waugh plate	1.17	2.31	.189	.116
Bradford K	1.34	2.45	.211	.137
Harvey	1.31	1.86	.206	.117
Coil springs	.99	1.90	.164	.175
Average	....	....	.117	.119

Table I, may be considered. The first column under "Time of Partial and Complete Closure" is for compression movements less than the full travel as developed with an initial velocity difference of approximately one mile an hour; the second column is for full gear travel developed with a velocity difference of two to five miles an hour, depending on the capacity of the various gears.

TABLE II—COMPARISON OF CALCULATED AND U. S. R. A. TEST RESULTS ON TIME OF DRAFT GEAR CLOSURE

Name of gear	s: Amount of full draft gear travel, inches. (Average of values in columns 12 and 13 plus ¼ values in column 14, pages 122-123 U. S. R. A. tests)	E: Energy taken up by gears, ft. lb. (One-half of values in Column 19, pages 122-123 U. S. R. A. tests)	$\sqrt{E}$	t: Time of closure, seconds — By formula (16)	t: Time of closure, seconds — U. S. R. A. tests, Column 15, pages 122-123 U. S. R. A. tests
National H-1	2.62	63,150	252	.091	.091
Sessions K	2.19	46,910	216	.088	.095
Miner A-18-S	2.70	48,900	221	.106	.098
Westinghouse NA-1	3.06	42,550	206	.129	.124
National M-1	2.71	44,796	211	.112	.104
Sessions Jumbo	3.00	45,370	213	.122	.121
National M-4	2.56	41,800	204	.110	.111
Cardwell G-18-A	3.29	36,465	191	.149	.144
Cardwell G-25-A	2.83	40,319	200	.123	.116
Westinghouse D-3	2.54	32,719	181	.122	.112
Gould 175	2.57	31,148	177	.127	.114
Murray H-15	2.68	29,210	171	.136	.127
Christy	2.23	34,115	185	.105	.104
Miner A-2-S	2.66	25,308	159	.145	.138
Waugh plate	2.39	22,433	149	.140	.116
Bradford K	2.53	18,963	137	.161	.137
Harvey	1.92	13,324	115	.145	.117
Coil springs	1.91	8,333	91.3	.182	.175

From the table it will be noted that the Waugh and Harvey gears take less time for complete closure than for partial closure, the times being .116 and .117 seconds for complete closure against .189 and .206 seconds for partial closure, respectively. The resistance-travel dynamic curves of these gears are upward like curve *b* of Fig. 1 (pages 248 and 260).

On the other hand, the Cardwell G-18-A and Minor A-2-S gears take more time for complete closure than for partial closure, the times being .144 and .138 seconds for complete closure against .119 and .074 for partial closure, respectively. The resistance-travel dynamic curves of these gears are downward like curve *c* of Fig. 1 except at the very end of the travel (pages 200 and 242).

The coil springs take nearly the same time for full and partial closure, the times being .175 seconds for complete closure and .164 seconds for partial closure. The resistance-travel dynamic curves of this gear are nearly straight like curve *a* of Fig. 1 (page 265). The most difficult curve to get test figures on is this straight one, as all the test curves are irregular, some tending downward at the outset and upward at the end of travel. The closest approach to a straight line would probably be a composite curve of all the curves, under which condition the various irregularities would be nearly ironed out. In this event, if the statements made at the outset are correct, then this composite curve should show the same time for complete as for partial closure. This is exactly what happens, as seen from Table I, for the average time for complete closure is .119 seconds against an average time of .117 seconds for partial closure, a difference of but little more than one per cent.

These gear performances, however, are not at all peculiar, for a little study will show that they are functioning exactly according to physical laws. The author will attempt to prove that such is the case.

Let us consider the condition where two cars have draft gears of the same capacity whose dynamic diagrams on compression follow a straight line, as curve *a*, Fig. 1 in which the following symbols represent:

s' = the maximum gear travel (not necessarily the full gear travel) for a given impact, in inches.
s = the full gear travel (maximum possible), in inches.
f = the gear resistance for any gear travel x, in lb.
F' = the gear resistance at the maximum gear travel s', for a given impact, in lb.
F = the gear resistance for the full gear travel s, in lb.
g = the acceleration of gravity, 32.2 ft. per sec. per sec.
S_a = the distance covered by car A during the period of gear compression, in ft.
S_b = the distance covered by car B during the period of gear compression, in ft.
t = the time of impact from the start up to the point of maximum compression for a given impact, in seconds.
V_a = the velocity of car A just before impact, in ft. per sec.
V_b = the velocity of car B just before impact, in ft. per sec.
W_a = the gross weight of car A, in lb.
W_b = the gross weight of car B, in lb.
x = any amount of gear travel at any time during an impact, inches.
E = energy taken up by gears at maximum gear closure, in ft. lb.

The two cars are represented in Fig. 2. Just at the point of impact, car *A* has a velocity of V_a and car *B* a velocity of V_b. These velocities may be of any magnitude with both in the same or opposite directions, but for simplicity the velocities will be considered in the same direction with V_a greater than V_b. As soon as impact begins these velocities change, so the velocities of cars *A* and *B* may be represented by the differential quantities $\frac{dS_a}{dt}$ and $\frac{dS_b}{dt}$.

The bodies of the cars then approach each other at a rate equal to $\frac{dS_a}{dt} - \frac{dS_b}{dt}$, which difference equals the sum of the rates at which both draft gears are compressed, or half this difference is the rate at which one gear is compressed, $\frac{1}{12}\frac{dx}{dt}$, viz.,

$$\frac{1}{12}\frac{dx}{dt} = \frac{1}{2}\left[\frac{dS_a}{dt} - \frac{dS_b}{dt}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

It is also known from the laws of momentum that the sum of the products of the velocities by their respective masses at any instant during impact equals the sum of the products of the velocities by their respective masses just before impact, that is

$$\frac{W_a}{g}\frac{dS_a}{dt}+\frac{W_b}{g}\frac{dS_b}{dt}=\frac{W_aV_a}{g}+\frac{W_bV_b}{g}$$

Or

$$\frac{dS_b}{dt}=\frac{W_aV_a+W_bV_b}{W_b}-\frac{W_a dS_a}{W_b dt} \quad \ldots\ldots(2)$$

Substituting (2) in (1)

$$\frac{dx}{dt}=6\left[\left(\frac{dS_a}{dt}-\frac{W_aV_a+W_bV_b}{W_b}-\frac{W_a dS_a}{W_b dt}\right)\right]$$

Collecting terms

$$\frac{dx}{dt}=\frac{6}{W_b}\left[(W_a+W_b)\frac{dS_a}{dt}-(W_aV_a+W_bV_b)\right] \quad \ldots\ldots(3)$$

In order to obtain a workable equation, the terms of equation (3) should be converted into terms of draft gear travel and force.

The term $\frac{dS_a}{dt}$ can be eliminated by an energy equation. In other words, the kinetic energy in car A, $\frac{W_a}{2g}\left[\frac{dS_a}{dt}\right]^2$, plus the kinetic energy in car B $\frac{W_b}{2g}\left[\frac{dS_b}{dt}\right]^2$, plus the energy taken up by both gears in traveling inward a distance x in developing a force from o to f, $\frac{2fx}{12\times 2}$, at any time during impact equals the kinetic energy in both cars just before impact, $\frac{W_aV_a^2+W_bV_b^2}{2g}$. Whence

$$\frac{W_a}{2g}\left(\frac{dS_a}{dt}\right)^2+\frac{W_b}{2g}\left(\frac{dS_b}{dt}\right)^2+\frac{fx}{12}=\frac{W_aV_a^2+W_bV_b^2}{2g} \quad \ldots\ldots(4)$$

Substituting equation (2) in equation (4)

$$\frac{W_a}{2g}\left(\frac{dS_a}{dt}\right)^2+\frac{W_b}{2g}\left[\frac{W_aV_a+W_bV_b}{W_b}-\frac{W_a}{W_b}\frac{dS_a}{dt}\right]^2+\frac{fx}{12}=\frac{W_aV_a^2+W_bV_b^2}{2g}$$

Dividing by $\frac{W_a}{2g}$ and expanding the second term

$$\left(\frac{dS_a}{dt}\right)^2+\frac{1}{W_aW_b}\left[(W_aV_a+W_bV_b)^2-2W_a(W_aV_a+W_bV_b)\frac{dS_a}{dt}+\left(W_a\frac{dS_a}{dt}\right)^2\right]+\frac{gfx}{6W_a}=\frac{W_aV_a^2+W_bV_b^2}{W_a}$$

Grouping the terms according to the degree of $\frac{dS_a}{dt}$,

$$\left(1+\frac{W_a}{W_b}\right)\left(\frac{dS_a}{dt}\right)^2-2\frac{(W_aV_a+W_bV_b)}{W_b}\frac{dS_a}{dt}=\frac{W_aV_a^2+W_bV_b^2}{W_a}-\frac{(W_aV_a+W_bV_b)^2}{W_aW_b}-\frac{gfx}{6W_a}$$

Dividing by $\left(1+\frac{W_a}{W_b}\right)$

$$\left(\frac{dS_a}{dt}\right)^2-2\frac{W_aV_a+W_bV_b}{W_a+W_b}\frac{dS_a}{dt}=\frac{W_aV_a^2+W_bV_b^2}{W_a+W_b}\frac{W_b}{W_a}-\frac{(W_aV_a+W_bV_b)^2}{W_a+W_b}\frac{1}{W_a}-\frac{gfx}{6(W_a+W_b)}\frac{W_b}{W_a}$$

Completing the terms for solving the second degree equation

$$\left(\frac{dS_a}{dt}\right)^2-2\frac{W_aV_a+W_bV_b}{W_a+W_b}\frac{dS_a}{dt}+\left(\frac{W_aV_a+W_bV_b}{W_a+W_b}\right)^2=\left(\frac{W_aV_a+W_bV_b}{W_a+W_b}\right)^2+\frac{W_aV_a^2+W_bV_b^2}{W_a+W_b}\frac{W_b}{W_a}-\frac{(W_aV_a+W_bV_b)^2}{W_a+W_b}\frac{1}{W_a}-\frac{gfx}{6(W_a+W_b)}\frac{W_b}{W_a}$$

Taking the square root and combining terms

$$\frac{dS_a}{dt}-\frac{W_aV_a+W_bV_b}{W_a+W_b}=\sqrt{\frac{W_b^2(V_a^2-2V_aV_b+V_b^2)}{(W_a+W_b)^2}-\frac{gfx}{6(W_a+W_b)}\frac{W_b}{W_a}}$$

Simplifying:

$$\frac{dS_a}{dt}=\frac{W_aV_a+W_bV_b+\sqrt{W_b^2(V_a-V_b)^2-\frac{gfx}{6}(W_a+W_b)\frac{W_b}{W_a}}}{W_a+W_b} \quad \ldots\ldots(5)$$

The next step, as already mentioned, is to convert V_a and V_b into terms of draft gear travel and resistance. To accomplish this, the fact can be used that the difference between the kinetic energy just before impact and the kinetic energy at maximum gear travel for the particular impact, $\frac{W_aV_a^2+W_bV_b^2}{2g}-\frac{W_a+W_b}{2g}\left[\frac{W_aV_a+W_bV_b}{W_a+W_b}\right]^2$, equals the energy taken up by the gears at the maximum travel (not necessarily the maximum possible travel of gear) of the given impact $\frac{2F^1s^1}{12\times 2}$, viz.,

$$\frac{W_aV_a^2+W_bV_b^2}{2g}-\frac{(W_aV_a+W_bV_b)^2}{2g(W_a+W_b)}=\frac{F's'}{12}$$

Expanding

$$W_a^2V_a^2+W_aW_bV_b^2+W_aW_bV_a^2+W_b^2V_b^2-W_a^2V_a^2-2W_aW_bV_aV_b-W_b^2V_b^2=(W_a+W_b)\frac{gF's'}{6}$$

That is

$$W_aW_b(V_a^2-2V_aV_b+V_b^2)=\frac{gF's'}{6}(W_a+W_b)(V_a-V_b)^2=\frac{gF's'}{6}\frac{W_a+W_b}{W_aW_b} \quad \ldots\ldots(6)$$

Substituting (5) in equation (3)

$$\frac{dx}{dt}=\frac{6}{W_b}\left[(W_a+W_b)\times\frac{W_aV_a+W_bV_b+\sqrt{W_b^2(V_a-V_b)^2-\frac{gfx}{6}(W_a+W_b)\frac{W_b}{W_a}}}{W_a+W_b}-(W_aV_a+W_bV_b)\right]$$

Combining terms

$$\frac{dx}{dt}=\frac{6}{W_b}\sqrt{W_b^2(V_a-V_b)^2-\frac{gfx}{6}(W_a+W_b)\frac{W_b}{W_a}} \quad \ldots\ldots(7)$$

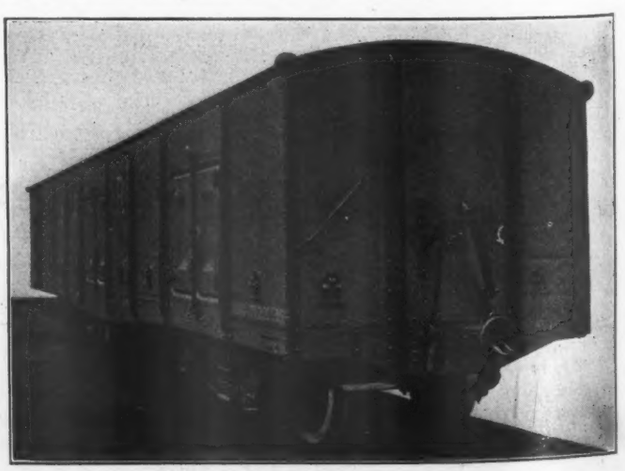
Substituting (6) in (7)

$$\frac{dx}{dt}=\frac{6}{W_b}\sqrt{W_b^2\frac{gF's'}{6}\frac{W_a+W_b}{W_aW_b}-\frac{gfx}{6}(W_a+W_b)\frac{W_b}{W_a}}$$

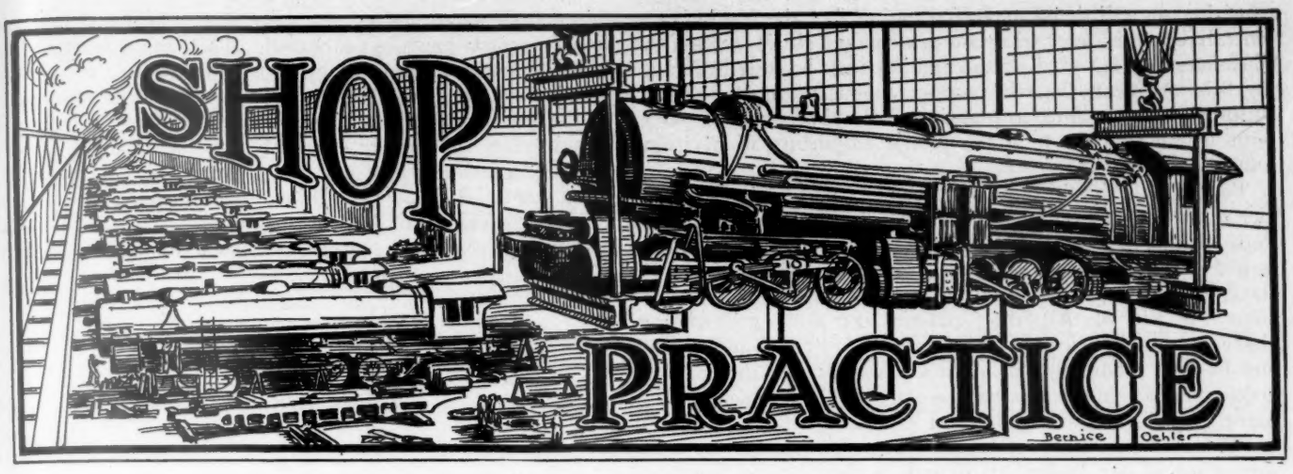
Simplifying

$$\frac{dx}{dt}=\sqrt{\frac{6g(W_a+W_b)}{W_aW_b}(F's'-fx)} \quad \ldots\ldots(8)$$

(The balance of this article, including the conclusions arrived at, will be given in the next issue.)



A 50-Ton All-Steel Gondola in South Africa



A Cost System of Locomotive Brake Repairs*

Canadian National Scheme of Centralizing This Work Effectively Controls Unit Expenditures

By W. H. Clegg
Supervisor of Air Brakes, Canadian National

THE design and manufacture of the air brake from its inception has been in the hands of trained men, and with this in mind, we have endeavored to maintain the equipment in order to permit of it to function as intended by the designer, rather than to encourage our men to make changes in the design supposed to overcome some difficulties that would not exist with only reasonably good maintenance.

We have inaugurated a comprehensive system of handling locomotive air brake work, which had for its original purpose the minimizing of locomotive failures chargeable to brake parts. The system contemplates that only certain light repairs will be made in engine houses, as outlined in the standard practice cards distributed to all concerned. Parts requiring repairs not authorized at such places are changed, the removed parts being promptly turned over to the stores department for shipment to designated repair points. Permissible repairs to air pumps in engine houses are shown on standard practice card No. 311.† All divisional points are supplied with complete compressor governors, compressors, distributing valves and all other parts enumerated in the forms illustrated.

CANADIAN NATIONAL RAILWAYS

STATEMENT OF STANDING STORE ORDERS FOR AIR BRAKE

MATERIAL REPAIRED AT..... DURING..... 192...

DESCRIPTION	S. O. No.	No. Repd.	Labour	Shop Expense	Material	Shop Expense	Total	Unit Cost
Triple Valves	1							
Feed & Red. Valves	2							
Distributing Valves	3							
Signal Valves	4							
Check Valves	5							
Brake Valves	6							
Boiler Check Valves	7							
Air Gauges	8							
Steam Gauges	9							
8½" Pumps	10							
9½" Pumps	11							
11" Pumps	12							
Pump Top Heads	13							
Pump Governors	14							
Inspirators & Injectors	15							
Lubricators	16							
Steam Hose	17							
Air Hose	18							
Signal Hose	19							
Angle Cocks	20							
Cut Out Cocks 1¼"	21							
Cut Out Cocks 1"	22							
Cut Out Cocks ¾"	23							
Cut Out & Drain Cocks ½"	24							
Conductor's Valve	25							
Retaining Valves	26							
Release Valves	27							

For Auditor of Stores & Mechanical Accounts.

Monthly Statement Furnished by the Auditor for Each Repair Point

Our experience has taught us that light repairs are seldom required when parts are properly installed and thoroughly overhauled at the main repair points. Limiting the engine house repairs has enabled us to effect very large reductions of air brake material in stock at all points other than where the repairs are effected.

For the purpose of illustrating the operation of the system take a No. 5 compressor governor found defective. It is removed complete and delivered to the local storekeeper, together with a signed requisition for one No. 5 compressor governor, which will be a repaired one taken from his stock and charged out to the engine at the unit cost of repairs to pump governors for the preceding month. This enables the engine house staff to apply the complete governor and O. K. the engine. The storekeeper will forward the removed governor to his department at the designated repair point, forwarding by mail a requisition covering one No. 5 compressor governor for repairs, indicating on the requisition the shipping tag number and how the governor was shipped. The receiving section of the stores department at the repair point, upon receipt of the requisition and governor, advise their shipping section to ship one No. 5 compressor governor to the local storekeeper on his requisition No. ——. The receiving section now delivers the defective pump governor to the Air Brake Repair Shop, obtaining the air brake foreman's receipt for it. The governor is duly cleaned, repaired and tested along with all other such valves in for repairs, after which it is delivered to the stores department which receipts for this and other items listed under the same shop order number. The governor is then placed in the stores stock ready for shipment again.

The shipping of all these parts back and forth is an item

*This is an abstract of a paper read before the Air Brake Association Convention, at Denver, Colo., May 1 to 4, 1923.

†This card contains instructions for washing out air compressors, which is done once every three months, and lists the following permissible repairs: Removing and replacing top and bottom heads, right and left main valve cylinder heads; renewing reversing valve rods; renewing upper steam or lower air cylinder gaskets; renewing air valves or valve cages; maintaining oil cups, strainers and piston rod packing.

requiring some little effort and attention, but the result from centralizing this work is most gratifying. It is necessary, of course, that the work at the repair points be well in hand. By this we mean that the stores department must be kept supplied with a sufficient quantity of complete repaired parts with which quickly to make return shipments to division points.

To facilitate the shipping of these parts and to simplify the clerical work on the part of the stores and air brake repair departments, our auditor of stores and mechanical accounts issued a standing store order for the repairs of each part of the Westinghouse brake equipment, as shown in the second column of Fig. 6. All labor, material and shop expenses are charged to their respective store orders and computed at the end of each month by the auditor of stores and mechanical accounts, who supplies us with a statement from each repair point of the material repaired on each standing shop order.

Figures from these statements are then taken by the supervisor of air brakes to prepare a comparative monthly

Stores No..... Form 261

SHOP REQUISITION FOR MATERIAL 456900

TO STOREKEEPER. .....192....

Required for..... Charge Acc't No.....

Quantity	DESCRIPTION	Class and Item	Weight or Measure	Price	Amount	

Delivered by..... .....

Storehouseman. Foreman.

Form 261—Requisition for Complete Parts Applied to Locomotives in the Repair Shops

statement showing the standing of the various repair points, a copy of which is forwarded to general superintendents of rolling stock, shop superintendents, traveling air brake inspectors and air brake foremen, together with a letter commenting on the items requiring investigation.

At the end of each month, the air brake foreman delivers to the stores and mechanical accountant, at the repair point, all his receipts for material delivered to the stores department for that month, all requisitions for complete parts given out to general repair shop for application to repaired engines for that month on Form 261 and also Form 289, showing all material requisitioned during the month, together with Form 274, showing unused material he may have on hand at the end of the month, which will be credited to the respective store orders. This information is required by the auditor when making up his monthly statement of costs on which he shows the quantity of parts repaired on each store order, and from which the unit prices for parts issued the following month are based.

Among the illustrations are shown a copy of the monthly statement for April, 1922, showing the quantity and the unit costs of each part repaired at each repair point. The copy of the quarterly statement for April 1 to June 30, 1922, gives an average that is more representative of our performance than the monthly statement. The semi-annual statement shows condensed data on costs, mileage, brake failures, etc. Copies of this statement for the periods from January 1 to June 30, 1922, and July 1 to December 31, 1922, are presented to show the increase in mileage per repair, reduction of unit costs and reduction of brake failures in the second period as compared with the first period. This statement, not shown, is also compiled for the entire 12 months' period.

It may occur to some that a greater number of complete parts are required to effect repairs under this system. While this may be true, it does not mean that additional new and complete parts must be purchased. This was a matter about which we were in doubt at the time we introduced these methods, but we very soon found that by the time we shipped in to the repair points all the defective, or bad order parts, found lying around our different shops and engine houses, we had an abundance of material to supply the outside points when put in serviceable condition. Furthermore, we also had, generally speaking, a liberal supply of parts to repair these different pieces of the equipment, when we removed all the

TO BE USED FOR STORE ORDER WORK ONLY Form 289

CANADIAN NATIONAL RAILWAYS

FOREMAN'S REQUISITION FOR STORE ORDER MATERIAL

120255

To Storekeeper. 192

Please Deliver the following to.....

Charge to Store Order No.....

QUANTITY	DESCRIPTION	Do not write beyond this line	WT. or Measure	PRICE	AMOUNT	

Delivered, Prices and extensions correct, Signed,

DUPLICATE

Form 289 Covers Material Used on Store Order Work

surplus material in stores stock at all outside points, to the stores at the designated repair point.

All requisitions for air brake material from divisional points to district or headquarter stores are subject to the traveling air brake inspector's approval. In addition to this, all storekeepers are provided with a list of parts to be carried in stock at their station. The district or headquarter stores will not ship to outside points any material not included in these lists. This double check on the material makes it impossible for these points to get material other than that required to maintain the equipment in accordance with standard practice cards. It is impossible to establish a satisfactory system unless you also control what particular parts shall be supplied. We are in very close touch with our stores department, and these relations are most helpful to us in our efforts to enforce adherence to our regulations. Occasionally

Shop No..... S. & M. A. No..... Form 274

Shop Scrap and Unused Material Credit Slip

TO STOREKEEPER 192

Station..... 75205

Please Receive the following as Credit to.....

Quantity	DESCRIPTION	DO NOT WRITE BEYOND THIS LINE	Weight or Measure	Price	Amount	

RECEIVED BY PRICES AND EXTENSIONS CORRECT SIGNED

STORE FOREMAN STORE ACCT. SHOP FOREMAN

On Form 274 Is Listed All Unused Store Order Material in the Shop at the End of the Month

complaints come in with regard to delayed shipments, but generally speaking, our stores department takes care of the situation very well.

Our traveling inspectors check over the train records for each 24 hours, investigate all brake failures and delays and report their findings. In addition to this, the general master mechanics supply us with a copy of the monthly statement of engine failures, which are checked and recorded each month against the inspector's report. The nature of each brake failure is carefully noted, and action taken as far as

possible to prevent a recurrence. Our bureau of statistics supplies a monthly statement of locomotive mileage which forms the basis of our records and permits a comparison of the service results of the various divisions per 100,000 locomotive miles.

The original purpose of all this was to obtain something tangible showing the character and extent of our locomotive brake failures, and the records now show the number to have been reduced from .41 to .25, or less than half of one failure for every 100,000 locomotive miles. A patient study of the failures as they occur has emphasized the need for better methods of installation, and our own shops, as well as

CANADIAN NATIONAL RAILWAYS

STATEMENT SHOWING COST OF REPAIRS TO AIR BRAKE MATERIAL ON STANDING MONTHLY STORE ORDERS AT THE GENERAL SHOPS

APRIL, 1922

DESCRIPTION	Store Order No.	MONCTON		WINNIPEG		TRANSCONA		ST. MALO		LEASIDE		SOUTH EDMONTON		NORTH EDMONTON	
		No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost
Triple Valves	1	432	1.37	824	.89	689	.64	8	1.59	240	.64	563	.88	842	.66
Feed & Red. Valves	2	66	2.64	143	1.22	51	1.52	38	2.80	41	1.55	53	1.04	41	1.93
Distributing Valves	3	..	...	15	13.08	21	5.99	7	4.77	8	2.91	19	5.00	23	2.95
Signal Valves	4	9	1.15	13	.81	13	1.47	11	2.94	5	1.00	1	.95	..	...
Check Valves	5	18	.93	35	.66	23	.54	11	.36	14	1.08	..	...	..	...
Brake Valves	6	19	4.69	48	2.30	32	7.65	12	2.78	12	1.77	4	4.83	3	4.88
Boiler Check Valves	7	6	4.87	..	...	13	37.71	8	4.48	..	...	..	...	1	13.42
Air Gauges	8	23	5.81	52	2.25	46	1.05	12	.77	22	.77	9	1.07	6	1.11
Steam Gauges	9	21	.83	47	2.58	23	1.67	14	.80	7	2.22	12	1.56	4	1.47
8½" C. C. Pumps	10	7	85.68	10	50.16	10	99.74	4	79.86	5	79.90	..	...	8	96.12
9½" Pumps	11	13	52.53	53	28.24	2	34.73	13	66.59	5	79.85	6	40.02	5	61.36
11" Pumps	12	2	86.50	..	...	7	71.63	2	105.78	..	...	..	...	..	...
Pump Top Heads	13	..	...	63	5.79	..	...	24	12.50	..	...	7	6.02	2	21.86
Pump Governors	14	18	3.03	27	3.65	31	5.21	15	5.64	16	5.13	10	4.80	10	4.64
Inspirators & Injectors	15	35	7.34	42	6.61	33	14.57	15	12.90	12	4.47	12	7.30	20	7.79
Lubricators	16	14	7.20	16	3.94	26	9.60	12	8.84	11	3.53	1	5.06	4	10.28
Steam Hose	17	255	3.56	217	3.25	213	3.37	..	...	..	...	..	...	..	...
Air Hose	18	846	1.30	505	1.79	465	1.50	..	...	..	...	..	...	..	...
Signal Hose	19	314	1.75	102	1.59	102	1.81	..	...	..	...	..	...	..	...
Angle Cocks	20	215	1.30	104	.49	212	.42	..	...	..	...	..	...	..	...
Cut Out Cocks 1¼"	21	141	.30	40	.93	..	...	..	...	..	...	..	...	..	...
Cut Out Cocks 1"	22	51	.57	18	.61	..	...	..	...	..	...	..	...	..	...
Cut Out Cocks ¾"	23	54	.60	..	...	..	...	..	...	..	...	..	...	..	...
Cut Out & Drain Cocks ½"	24	17	.25	..	...	..	...	..	...	..	...	..	...	..	...
Conductor's Valves	25	3	.34	..	...	..	...	..	...	..	...	..	...	..	...
Retaining Valves	26	62	.65	6	1.10	..	...	..	...	..	...	..	...	..	...
Release Valves	27	68	.56	100	.38	231	.25	..	...	..	...	..	...	..	...

W. H. CLEGG,
Supervisor of Air Brakes.

REMARKS:

CANADIAN NATIONAL RAILWAYS

QUARTERLY STATEMENT SHOWING AVERAGE UNIT COST OF REPAIRS TO ALL BRAKE MATERIAL FROM APRIL 1st, 1922, TO JUNE 30th, 1922, ON STANDING MONTHLY STORE ORDERS AT THE GENERAL REPAIR SHOPS

DESCRIPTION	Store Order No.	MONCTON		WINNIPEG		TRANSCONA		ST. MALO		LEASIDE		SOUTH EDMONTON		NORTH EDMONTON	
		No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost	No. Repd.	Unit Cost
Triple Valves	1	1529	1.36	2847	.92	2705	.59	37	1.47	710	.75	2044	.86	2130	.59
Feed & Red. Valves	2	169	3.28	511	1.32	190	1.56	159	2.15	125	1.33	129	2.11	223	2.12
Distributing Valves	3	12	6.06	66	9.43	84	5.73	23	4.32	30	3.43	39	5.98	68	3.75
Signal Valves	4	34	1.87	56	1.38	51	1.64	28	2.68	17	1.52	4	3.72	..	...
Check Valves	5	47	.83	136	.31	83	.57	44	.42	35	.64	1	.89	..	...
Brake Valves	6	59	3.84	137	2.19	121	5.73	45	2.87	34	2.10	9	4.41	11	3.42
Boiler Check Valves	7	18	3.89	..	...	49	24.35	8	4.48	..	...	..	...	5	11.65
Air Gauges	8	92	3.18	221	1.55	274	.80	61	.44	61	.85	20	1.25	30	1.12
Steam Gauges	9	98	1.27	154	1.81	177	1.13	32	.80	28	2.36	19	1.59	20	1.00
8½" C. C. Pumps	10	23	96.58	36	55.76	40	75.26	10	87.58	17	77.65	..	...	18	95.42
9½" Pumps	11	38	66.86	164	31.90	19	34.74	40	72.28	18	51.79	24	26.36	37	47.19
11" Pumps	12	18	56.18	..	...	21	44.30	2	105.78	..	...	..	...	5	77.26
Pump Top Heads	13	4	16.52	76	5.81	12	6.92	79	8.64	3	16.87	13	6.86	26	10.04
Pump Governors	14	66	5.25	122	3.63	90	4.66	52	6.04	38	6.08	27	4.51	36	4.28
Inspirators & Injectors	15	105	10.11	154	7.25	127	12.85	57	10.69	40	8.75	28	5.70	62	6.49
Lubricators	16	47	7.95	70	3.35	84	7.48	30	8.90	25	6.95	3	4.60	86	7.92
Steam Hose	17	817	3.10	592	3.03	445	2.66	..	...	155	2.51	..	...	18	6.12
Air Hose	18	2769	1.47	2498	1.54	955	1.63	..	...	565	1.79	..	...	483	1.73
Signal Hose	19	905	1.62	435	1.44	310	1.38	..	...	195	1.34	..	...	781	1.32
Angle Cocks	20	1275	.80	365	.59	379	.57	..	...	..	...	..	...	100	1.90
Cut Out Cocks 1¼"	21	433	.44	117	.63	72	.63	..	...	..	...	..	...	..	...
Cut Out Cocks 1"	22	122	.54	47	.48	31	.62	..	...	..	...	..	...	..	...
Cut Out Cocks ¾"	23	178	.49	..	...	..	...	..	...	..	...	..	...	..	...
Cut Out & Drain Cocks ½"	24	25	.31	..	...	..	...	..	...	..	...	..	...	..	...
Conductor's Valves	25	3	.34	..	...	..	...	..	...	..	...	..	...	..	...
Retaining Valves	26	103	.64	6	1.10	..	...	..	...	..	...	..	...	..	...
Release Valves	27	195	.49	100	.38	231	.25	..	...	..	...	..	...	..	...

W. H. CLEGG,
Supervisor of Air Brakes.

REMARKS:

CANADIAN NATIONAL RAILWAYS

STATEMENT OF PERFORMANCE AND COST OF AIR BRAKE MATERIAL REPAIRED
FROM JANUARY 1st, TO JUNE 30th, 1922

DESCRIPTION	Store Order No.	No. Repd.	Total Cost of Repairs	Total Engine Miles	Valves Rep'd Per 100,000 Mls.	Cost of Repairs Per 100,000 Mls.	Eng. Miles Per Valve Repair	Unit Cost Per Valve Repair	Brake Failure Per 100,000 Mls.
Triple Valves	1				X	X			
Feed & Red. Valves	2	3058	6,361.68	18,729,891	16.1	33.50	6,125	2.08	
Distributing Valves	3	648	4,106.83	"	3.4	22.00	28,904	6.34	
Signal Valves	4	357	628.23	"	1.8	3.25	52,465	1.76	
Check Valves	5	665	333.09	"	3.6	1.50	28,165	.50	
Brake Valves	6	771	3,161.67	"	4.1	16.75	24,293	4.10	
Boiler Check Valves	7								
Air Gauges	8	1396	1,847.83	"	7.6	10.00	14,133	1.32	
Steam Gauges	9								
8½" C. C. Pumps	10)								
9½" Pumps	11)	1090	54,782.49	"	5.9	297.75	17,181	50.27	.41
11" Pumps	12)								
Pump Top Heads	13	376	2,993.77	"	2.0	16.00	49,814	7.96	
Pump Governors	14	920	4,571.56	"	4.9	24.25	20,539	4.95	
Inspirators & Injectors	15								
Lubricators	16								
Steam Hose	17								
Air Hose	18								
Signal Hose	19								
Angle Cocks	20								
Cut Out Cocks 1¼"	21								
Cut Out Cocks 1"	22								
Cut Out Cocks ¾"	23								
Cut Out & Drain Cocks ½"	24								
Conductor's Valves	25								
Retaining Valves	26								
Release Valves	27								

REMARKS: X Decimal Figures are Approximate.
.43c per Locomotive Mile.

W. H. CLEGG,
Supervisor of Air Brakes.

Canadian locomotive builders, have joined with us heartily in an endeavor to effect improvements.

In dealing with that portion of the subject relating to maintenance cost, it will be interesting to note that while not intentional on the part of the management, a friendly rivalry has developed among the air brake foremen, and they await with keen interest the arrival each month of the comparative cost sheet. The discussion during our periodical meetings finds these gentlemen advancing the most logical reasons for modifying or discontinuing entirely certain practices, as a means of securing further reductions in costs, and mistakes in accounting cannot now easily pass the scrutiny of these men.

It is no longer possible for outside men to abuse air

CANADIAN NATIONAL RAILWAYS

STATEMENT OF PERFORMANCE AND COST OF AIR BRAKE MATERIAL REPAIRED
FROM JULY 1st TO DECEMBER 31st, 1922

DESCRIPTION	Store Order No.	No. Repd.	Total Cost of Repairs	Total Engine Miles	Valves Rep'd Per 100,000 Mls.	Cost of Repairs Per 100,000 Mls.	Eng. Miles Per Valve Repair	Unit Cost Per Valve Repair	Brake Failure Per 100,000 Mls.
Triple Valves	1				X	X			
Feed & Red. Valves	2	3477	5,377.36	24,294,950	14.3	22.25	6,987	1.55	
Distributing Valves	3	785	4,160.66	"	3.8	17.25	30,949	5.30	
Signal Valves	4	352	551.25	"	1.5	2.25	69,020	1.57	
Check Valves	5	632	211.97	"	2.6	.88	38,441	.34	
Brake Valves	6	783	2,074.89	"	3.2	8.50	31,028	2.65	
Boiler Check Valves	7								
Air Gauges	8	1374	1,397.98	"	5.6	5.75	17,682	1.02	
Steam Gauges	9								.25
8½" C. C. Pumps	10)								
9½" Pumps	11)	1010	46,455.25	"	4.2	191.25	24,053	46.00	
11" Pumps	12)								
Pump Top Heads	13	125	1,271.56	"	.5	5.25	194,359	10.17	
Pump Governors	14	870	3,052.02	"	3.5	12.50	27,925	3.51	
Inspirators & Injectors	15								
Lubricators	16								
Steam Hose	17								
Air Hose	18								
Signal Hose	19								
Angle Cocks	20								
Cut Out Cocks 1¼"	21								
Cut Out Cocks 1"	22								
Cut Out Cocks ¾"	23								
Cut Out & Drain Cocks ½"	24								
Conductor's Valves	25								
Retaining Valves	26								
Release Valves	27								

REMARKS: X Decimal Figures are Approximate.
.27c per Locomotive Mile.

W. H. CLEGG,
Supervisor of Air Brakes.

brake parts by hammering, etc., without damage being noted by the air brake foreman. Since this increases his costs unnecessarily, he naturally enters a strong protest. The same applies to material purchased from manufacturers, or made in the company's own shop. The material must not require extra operations in order to make it serviceable, otherwise the foreman is liable to refuse acceptance, and the shop superintendent can not do otherwise than uphold his decision, if same conforms to reasons and proofs. Under this system the air brake foreman cannot afford to accept inferior material, nor use obsolete machinery, as it may affect both the cost and the quality of his work.

A noteworthy feature came to light during the inception of this work. Records showed repeatedly that the labor charge was much lower in certain shops than in others, while a knowledge of the working conditions indicated that the reverse should be the case. The fact soon developed that the shops referred to as being low in labor costs were using quantities of new material unnecessarily while the bills for new material in the other shops were appreciably lower.

Only a casual glance at this report is necessary to indicate that there is still much to be done; however, we have tried to apply as far as possible the valuable advice submitted in previous papers of this association. The air brake supervisor who fails to apply himself diligently to the task of eliminating waste and developing a repair cost system, is being deprived of a great opportunity for rendering really worth while assistance to the company he serves.

Locomotive Scheduling at the Silvis Shops

Part 5 — Performance Data

New System of Locomotive Scheduling Now Being Installed at the Silvis Shops of the C. R. I. & P.

By L. C. Bowes*, G. E. Sandstrom†, and H. K. Robinson‡

THE former articles have dealt primarily with the functions and routine of the locomotive scheduling system, together with the necessary organization for carrying it on and with predictions as to what the ultimate expectations would be with such a system when carried to 100 per cent completion.

After four months of actual operation, a very gratifying showing has been made, which substantiates the prediction that it would be possible to double the output of the locomotive shop by a systematic and co-ordinated effort of intensive analysis and a study by reason of centralized control and delegated authority.

The accompanying analysis reflects the uniform improvement made, month by month, during the last four months.

By reason of a close analysis of the schedule, it can be stated that the amount of work performed each month, as against the several classes of repair, was of uniform magnitude. In fact, during the last two months shown there was actually performed more work on light repairs for which no credit is shown.

By virtue of existing conditions, the policy adopted was that of maintaining an output and reducing the actual working force during this period. A further analysis, as predicted in previous articles, is based on the possibility of reducing the actual man hours per locomotive to 2,500. This, with a normal force of 1,000 men, would be the equivalent of an output of 75 locomotives per month, all of which would be heavy classified repairs.

A	B	C	D	E	F	G	H
Month	Monthly output locomotives	Total man hours per month	Average man hours per locomotive	Decrease aver. man hours per locomotive, per cent	Increased efficiency, per cent	Equivalent monthly output, locomotives	Equivalent increased efficiency, per cent
May	26	169,592	6,523	..	..	..	..
June	32	186,606	5,831	11	12	36	38
July	32	179,913	5,622	14	16	37	42
August	32	160,000	4,850	26	34	43	65
September	32	120,360	3,761	43	73	55	111

The following explanatory notes will serve to make the meaning of the above table clear:

Column A: Self explanatory.

Column B: Actual locomotives O.K'd to transportation department during month.

Column C: Actual man hours on classified repairs as reflected by actual analysis of production or work order tickets.

Column D: Average man hours per locomotive, arrived at by dividing "C" by "B."

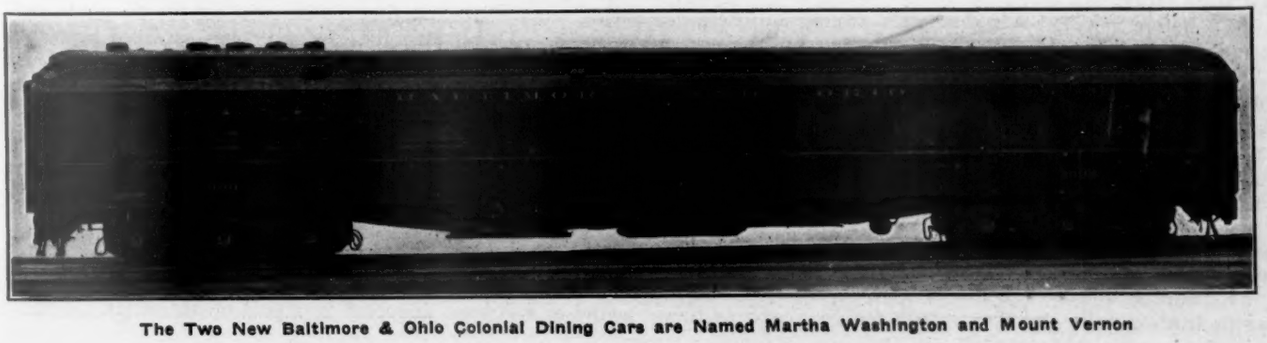
Column E: Arrived at by dividing "D" for any month by "D" for May and subtracting from 100 per cent.

Column F: Arrived at by dividing "D" of May by "D" of any month and subtracting 100 per cent.

Column G: Arrived at by multiplying "D" of May by "B" of any month and dividing by "D" of the same month. (This is for the four months' analysis period only.)

Column H: Arrived at by dividing "G" of any month by "B" of May and subtracting 100 per cent. (This for the four months' analysis period only.)

*Production engineer, C. R. I. & P.
†Industrial engineer, Roberts-Pettijohn-Wood Corporation.
‡Special accountant, C. R. I. & P.



The Two New Baltimore & Ohio Colonial Dining Cars are Named Martha Washington and Mount Vernon

Safety Suggestions of the Atlantic Coast Line

THE General Safety Committee of the Atlantic Coast Line is distributing a folder among mechanical department employees outlining a series of safety suggestions given below which, if always borne in mind, would result in a very noticeable reduction in the number of accidents.

1. Many accidents are due to handling material, to material falling and to men being caught between material. In lifting operations it is important in each movement that the men act in unison, both in taking hold and letting go.

2. When it is necessary to use runways, horses, ladders, scaffolds or other supports, employees should know by personal test, examination, or other sufficient methods, that they are in a safe condition and properly placed before being used.

3. Great care should be taken by men working above not to drop any material unless it is necessary, and then not without first giving due warning to those below.

4. When you complete a job, never leave tools or material overhead.

5. Crane men are forbidden to move load without a signal from the proper man and not to move crane without first sounding gong, nor raise the hook above limit switch.

6. Take no unnecessary chances in passing under a load being moved by crane or other mechanism.

7. In cutting off bolts or rivets, be very careful to see that the heads are not allowed to fly to where other workmen are passing or working. This should be avoided by holding a broom on same or making use of some other approved safety device to prevent injury.

8. Do not grind at emery wheels or operate a machine from which chips are flying without using goggles.

9. Do not use welding or cutting torch without using shield over your eyes.

10. Goggles furnished by the company should be worn at all times when there is danger of flying particles entering the eye. If you are in doubt, consult your foreman.

11. Covers for drop pits, manholes and other openings should be kept in place when not in use.

12. Do not attempt to operate a machine unless you are *thoroughly qualified* in its operation. Do not work with any machine unless authorized by the foreman in charge.

13. Do not file right-handed on lathe as it brings operator too close to chuck or carrier.

14. Do not clean and oil machinery while in motion.

15. Do not remove guards from machinery for the sake of convenience. Machine should not be operated without guards in proper place.

16. Tools found defective should be reported to foreman in charge or turned in at toolroom.

17. In handling material at the steam hammer, always stand at the side of the forging or piece you are holding and always use tongs.

18. Do not jack a car without first blocking the wheels.

19. Do not use anything but regular jack handles when operating jacks.

20. Before moving an engine, walk around and examine it and ring the bell as a warning.

21. Do not go under a car or between cars for the purpose of making inspection or repairs without first knowing that you are fully protected.

22. Do not wear long, loose sleeves or gloves around revolving machinery. To insure safety, sleeves should be short and tight fitting.

23. Do not break air hose on cars with stopcocks open and train line charged. Stopcocks must be closed before uncoupling hose.

24. Special attention should be given to boards containing protruding nails and they should not be placed so they will be a source of injury. Nails should be turned down when possible.

25. Do you know there is nothing gained by taking chances and the safety device is a careful man?

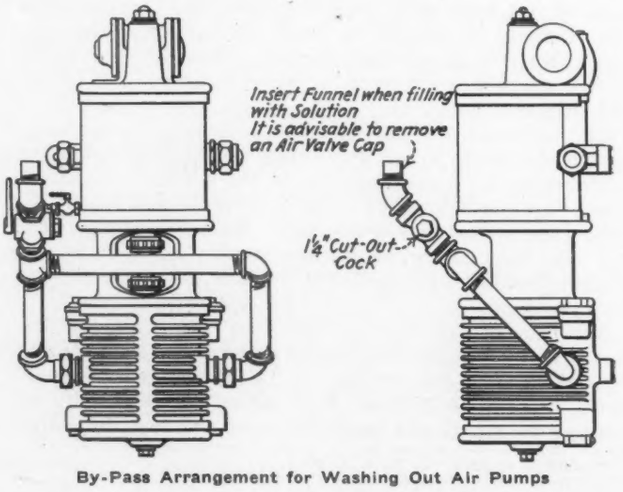
26. Will you do your work in a safe and careful manner and try to avoid injury to yourself and others?

Canadian National Air Pump Washout Arrangement

THE drawing shows a simple arrangement of pipe connections which is used by the Canadian National for washing out the compressor cylinder of locomotive air pumps. With this device attached to the pump and the air cylinder filled with the cleaning solution, no outside supply of solution is necessary.

Before this by-pass arrangement was developed experiments were made with several designs of air pump washout devices and with solutions of varying strengths and mixtures. The commonly used barrel arrangement with suitable pipe connections leading to the air pump cylinders, requires a large quantity of solution and the churning to which it is subjected when the pump is being washed out causes the soapy ingredients introduced to prevent the cutting of the cylinder walls, valves and seats to separate in a foamy mass which floats on the surface of the solution in the barrel, so that its value is lost. For the same reason other types of washout equipment using open liquid containers, whether located on the running board or attached to the pump, were found to be unsatisfactory.

With the arrangement shown in the drawing the plug cock in the filling connection is opened and the air cylinder filled



By-Pass Arrangement for Washing Out Air Pumps

with the cleaning solution, one of the upper air valve caps being removed so that the solution will readily flow into the cylinder. Then, with the air valve cap replaced and the filling cock of the washout device closed, the pump is operated at about 20 strokes per minute either by steam from the locomotive or the roundhouse blower line. When the cleaning is completed the washout solution is drawn off and clean water worked through the pump in the same way.

Experience on the Canadian National has led to the use of a solution of moderate strength, circulated through the pump for about four hours, rather than a solution of greater strength used for a shorter time. The solution used on the Canadian National consists of six cans of lye and one-half pound of soft soap dissolved in a pail of hot water.

Locating Centers for Shoes and Wedges

General View of the Burlington Shops at Hannibal, Mo.

New Method for Securing Main Centers Ensures Correct Alinement of Engine Truck, Drivers and Trailers to Prevent Wheel Cutting *

By T. E. Paradise
Master Mechanic, C. B. & Q., Hannibal, Mo.

THE proper locating of centers for the laying off of shoes and wedges is one of the most important tasks in connection with the repair work of the locomotive, for the performance of the locomotive will depend, to a great extent, upon the accuracy with which the shoes and wedges are alined.

The work of laying out and fitting shoes and wedges has usually been handled by a few individual mechanics in most locomotive repair shops, as the average mechanics of today have not been trained, neither do they take sufficient interest to master the problems that are confronted in the handling of this work, and unless they are ambitious and willing to exert themselves they will not secure the knowledge of the most important points. One of the particular reasons why so few mechanics are able properly to handle this work is the assignment of it to individual men who grudgingly part with any information in regard to the handling; this has made the work appear to the younger and inexperienced mechanic as mysterious or confusing.

The present methods that are used in practically all modern shops vary slightly from the practices followed in the last twenty years, during which time a number of changes in the design of the locomotive have taken place. The increased size of the locomotive has extended the wheel base, and has made it of the utmost importance that the alinement of drivers, engine truck and trailers be perfect. A failure properly to perform this work causes a large amount of maintenance work in the roundhouses, due to changing tires, and also shortens the life of rails, as the wearing of tires means a corresponding wear on the track.

From my observation of the handling of locomotives in roundhouses, I have found that there is a constant changing of tires, due to the cutting of flanges, a study of which has brought out the fact that the cause of the greater portion of these cut tires is the improper alinement of the engine truck and the trailer with the drivers. The cutting of driving wheel tires in the operation of locomotives is causing roundhouse maintenance forces to carry an unnecessary expense and burden, due, in the majority of cases, to the incorrect method used when locomotives are given general repairs.

The prevailing practice in securing the main centers from which shoes and wedges are laid off is responsible for the greater number of cut flanges, due to these centers being located from the cylinders independently, and not in conjunction with the engine truck and trailers. In the location of these centers a number of methods are used which are responsible for the cutting of tires, and not the curvature of the track over which the locomotive operates, unless it is operated continuously on a sharp curve—the locomotive headed while going in one direction and making the reverse movement backing up, as a switch locomotive operating in yards and switching over leads, a condition of operation which reduces the life of tires on switch locomotives over 50 per cent. A considerable amount of tire wear can be reduced by oiling the inside face of the ball of the rail on the outside rails of curves, which will not only save the tires, but will also save the rails, as when rails become worn to any extent, the tires are worn much more rapidly.

The methods used in the roundhouse are responsible for a large number of tires being cut, due to improper maintenance, such as allowing the engine truck and trailers to become rigid, thereby creating a long wheel base, which generally cuts engine trucks and front drivers, or trailers

* Paper submitted in Erecting Shop Competition.

and rear drivers; also allowing the locomotive to become out of plumb, which wears three point hangers on engine trucks unevenly, and carries the engine to one side.

Throwing Drivers Not Advisable

The general practice to overcome this is to throw the drivers on one side either forward or back, to overcome the cutting. This involves a considerable amount of work and does not in all cases prevent the driving flanges from cutting, as a road locomotive is equipped with an engine truck which guides the locomotive, controls the alinement, and by its position carries the locomotive in correct or incorrect location in reference to the main drivers. In throwing the driving wheels either forward or back, this may aline the drivers with the engine truck, but it creates a change in the driving wheels laterally, and while it may prevent further cutting of the driver that is cutting, will cause other drivers to cut and will throw the entire engine out of alinement.

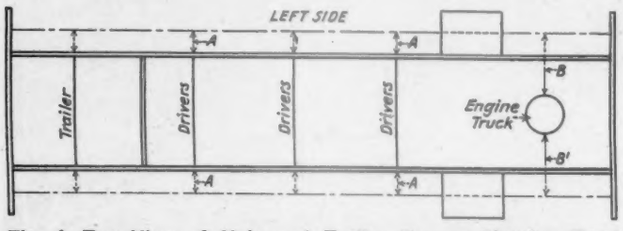


Fig. 1—Top View of Main and Trailer Frames Showing Front Truck Center Casting, Drivers and Trailers

This is clearly shown in Fig. 2, which shows lines set horizontally the length of the frame, an equal distance *A* from the frame at the front driver and the rear driver on both sides of the locomotive. The measurements from *C* and *D* from these lines to the engine truck center casting show the center casting to be out to one side, the distance *C* being greater than *D*. This condition will cause the drivers on the left side to cut, therefore, in the method of throwing the drivers, the right side will be thrown back, which will carry the main center of each driver back the distance the drivers were thrown. This would change the angle between the driving axles and the two lines parallel with the frame.

A study of Fig. 2 will show that this method may prevent further cutting of a certain flange on a locomotive without a trailer, but will create a very bad condition on a locomotive with a trailer. By moving the line on the right side away from the locomotive until it is an equal distance from the center casting as that on the left side, measurements then made to the frame from this line at each jaw will show that a radical change must be made in the thickness of the hub plates on the drivers. To keep the drivers in line it would be necessary to increase the hub plates on the right side, which is not practical. The center casting must be moved to a central position of the lines as shown in Fig. 1 where the distances *B* and *B'* are equal. This demonstrates that the method of throwing the drivers either ahead or back cannot be used as a preventive for tires cutting when locomotives are equipped with engine truck and trailer, as the engine truck and trailer are responsible for the cutting of the flanges, and occasionally it is found that the incorrect thickness of hub plates is responsible for the cutting of tires. Therefore, you cannot rectify the defective location of engine truck or trailer by applying the remedy to the drivers.

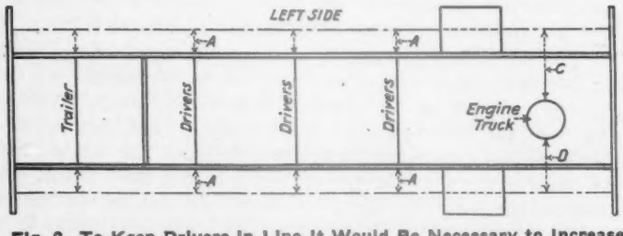


Fig. 2—To Keep Drivers in Line It Would Be Necessary to Increase Hub Plates on Right Side Which Is Not Practical. Center Casting Must Be Moved to Central Position

Adjusting Three-Point Truck Hangers

By changing the alinement of the three-point hangers, a locomotive can be carried away from the driving flanges on either side, and prevent further cutting. This can be done by adding a liner or material with an acetylene torch, to the inside bearing faces of the hangers on one side, and to the outside bearing faces of the other hangers. This will carry the locomotive to the side where the material has been added to the outside bearing faces of the hanger, as shown in Fig. 3. In this figure the center casting and the three-point hanger are in position. Material added to faces marked *R, R'* will carry the locomotive to the right side and overcome cutting of tires on the left side. To correct tire cutting on the right side material should be added to the faces marked *L, L'*. The amount to be added depends upon the length of the hanger. If the length is twice the width, each ⅛ in. of material added carries the center casting ¼ in. laterally.

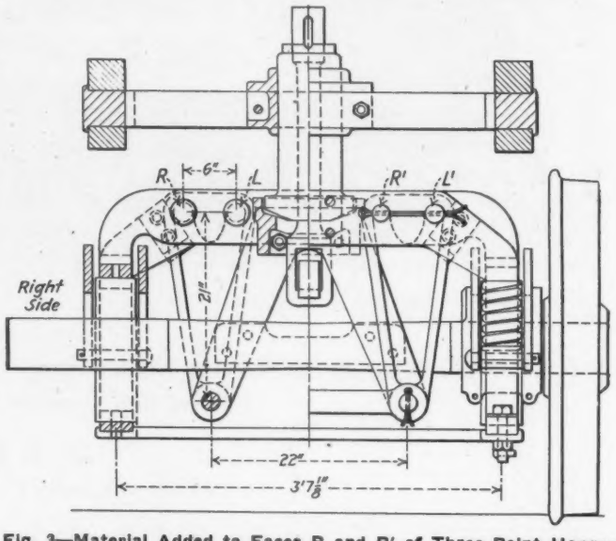


Fig. 3—Material Added to Faces R and R' of Three-Point Hanger Will Carry the Locomotive to the Right Side and Reduce Cutting on the Left Side

If the proper methods are used in handling when locomotives receive general repairs, it will reduce the burden on roundhouse forces and enable them to make really necessary repairs. The changing of tires is an unnecessary repair, because it is avoidable, except when long wheel base locomotives are operated on sharp curves, or when rails on curves are badly worn; but such cases are comparatively few.

Locating Main Centers

The method used for the location of the main centers must be such that the location of the engine truck center, and any difference in thickness of hub plates on drivers and trailer trucks can be ascertained without a transfer being made of any of these points from any fixture, such as engine truck center pin or cylinders, and they must be located through one medium. To do this, two lines should be set parallel to main frames, as shown in Fig. 4 (one on each side of the main frames), extending from the front beam to the rear of the trailer frame, extending through cylinders, and set a given distance from the frame at the front jaw and the same distance from the frame at the back jaw. A straight-edge

is then placed through both main jaws against the shoe faces, and adjusted at right angles to the two parallel lines. By using a square, the blade maintained perpendicular by a parallel strip on top of the frame with the lower edge in contact with the straight-edge, a line is then scribed on the side of each frame, which locates the point from which the main centers can be secured.

The center casting is then located by measuring from the line on each side at the front end. It is of the utmost importance that the center casting be in the center and in direct line with the drivers, as it is the guide to the locomotive, and if not located with the drivers, will carry the locomotive to one side or the other. This is responsible for more sharp flanges than any other defect.

If the locomotive has three, four or more sets of drivers, the distance from the line to each jaw should be measured to develop any distortion of the frame, and to secure the difference in thickness of the hub plates which such distortion will cause.

The frames are often distorted by welding while in place, which is a common practice, and is the cause of one tire cutting when drivers, engine truck, and trailers are in line. It is also necessary to measure to each trailer frame from the line at the trailer jaw to secure the difference in thickness of hub plates, so that trailer wheels will be in line with the drivers.

The engine truck center casting must be in the center after the engine truck has been built up, and the engine truck should be measured so that it positively is known that the engine truck center casting is in the direct center between the flanges of the wheels. This can be measured directly on a single axle truck, and on a double axle truck a straight edge can be placed along the throat of the flanges and the measurement taken to the center casting. It should not be taken for granted that the casting is in the center, but it should be developed by accurate measurement after the truck has been built up.

The elimination of sharp flanges will not only relieve an excessive burden from the maintenance forces in the roundhouse, but will reduce the wheel work in the back shop, in wheel gangs, and on wheel lathes. It will extend the life of tires, as a flange worn to gage requires the removal of from ⅜ in. to ½ in. of metal to enable the flange to be brought up to standard. This reduces the life of the tire involved very rapidly, and makes it necessary to reduce all the other tires in the set the same amount. It will also reduce the wear on rails.

Heel Wrench for Jacket Bands

By F. W. Bentley, Jr.

THE one piece jacket band is sometimes decidedly unhandy to hold in place while putting in the band screw, more especially so when the band happens to be located on an air pump upon an engine. Particularly is it inconvenient on a hot engine where working quarters are cramped and with a considerable number of other conditions frequently present to make the job a disagreeable one. The accompanying illustration shows a very handy heel wrench with which the

A Handy Little Tool for Use in Applying Jacket Bands

slack of the band against the jacket can be held after the hole has been drifted into place for the screw. The hook and heel hold the band quite firmly with but little pressure, leaving the other hand free to insert the screw. A wrench of this type can easily be made by anyone from a piece of ¼-in. steel wire bent into a shape to fit the size of air pump on which it is to be used. A total length of from 6 in. to 7 in. has been found to give a convenient grip.

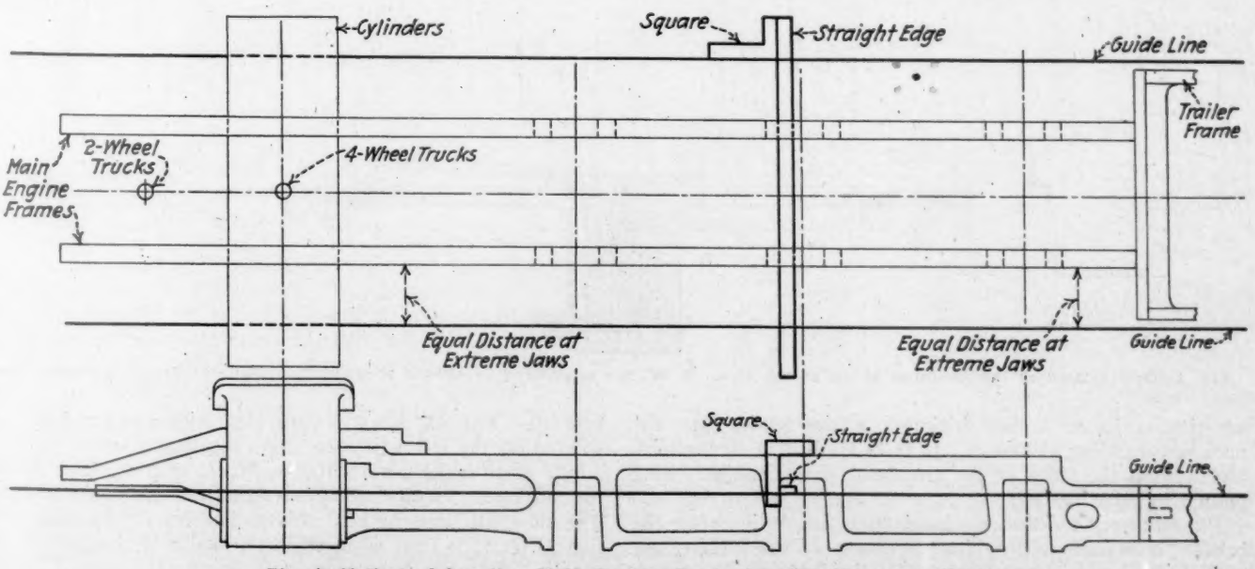


Fig. 4—Method of Locating Main Centers for Laying Out Shoes and Wedges

Babbitting Crosshead Shoes

OWING to the large number of crosshead shoes which have to be babbitted in the average railroad shop in the course of a year, a great deal of attention has been given to machines and devices for performing the babbitting operation. One of the most effective equipments yet developed is that shown in the illustrations, used in the Scranton shops of the Delaware, Lackawanna & Western. The device illustrated in Fig. 1 is for babbitting shoes without removal from the crossheads, while that shown in Figs. 2 and 3 is intended for babbitting new crosshead shoes, or those which have had to be removed on account of loose or defective bolts. The particular feature of both of these devices is the accuracy of the work done with them and the consequent saving of time through the elimination of subsequent machining.

Referring to Fig. 1, the construction and operation of the crosshead babbitting device will be evident. Different sizes of crossheads can be accommodated, the range being from 12 in. to 21 in. between the faces of the crosshead shoes. The shoe width can vary from 5 in. to 6½ in. The device consists of a cast-iron base plate *E* provided with vee-ways along which the uprights *MM* are adjustable together or apart by means of an adjusting screw and handles *HH*. Adjustment for the width of the right crosshead shoe is obtained by means of rack *N* and pinion *T* which operate the taper wedges *WW*. A similar rack and pinion operate adjustable wedges to suit the width of the left crosshead shoe.

In operation, the crosshead to be babbitted is up ended on the crosshead supporting rod and bushing *P*. Handles *HH* are turned until the working faces of uprights *MM* are the same distance apart as the guides, *plus* a slight additional amount required for running clearance. The wedges *WW* are then adjusted to the thickness of the guides *plus* the necessary running clearance. Clay is applied at the bottoms and around the sides of the crosshead shoes, babbitt being poured in from the top.

Power to remove the crosshead from the device after the babbitt is poured is provided by means of the jacking arrangement shown in cross section at the bottom. By means of a handle applied to the squared end of shaft *K*, a powerful lifting action is applied to crosshead lifting rod *R*, bushing *P* and the crosshead, forcing the latter out of the device. A particularly good job is obtained by this method of babbitting crossheads and by means of the two adjustments mentioned, just the proper allowance for play can be made so that no subsequent machining is required.

For babbitting separate crosshead shoes, the device illustrated in Figs. 2 and 3 is used to advantage. Fig. 2 shows the bottom section in which the crosshead shoes are placed, and Fig. 3 the top section which, when set for the proper clearance, forms the upper part of the mold. Referring to Fig. 2, the bottom section is constructed as shown of cast-iron. The crosshead shoe to be babbitted is placed on the four 1-in. pins MMM_1M_1 with the guide bearing surface

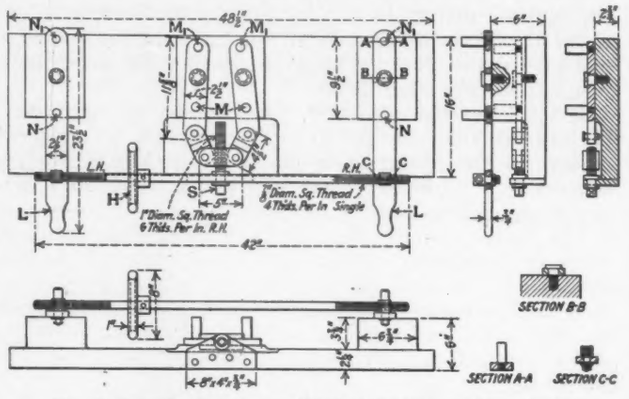


Fig. 2—Crosshead Shoe Babbitting Device—Bottom Section

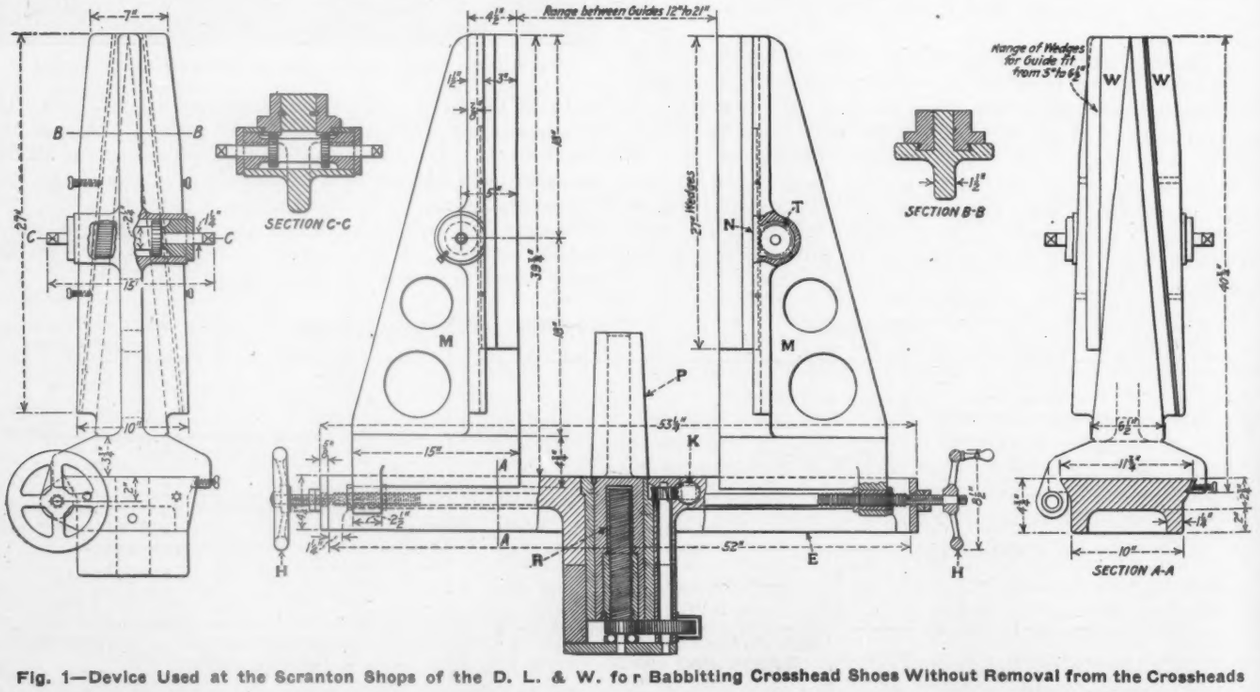


Fig. 1—Device Used at the Scranton Shops of the D. L. & W. for Babbitting Crosshead Shoes Without Removal from the Crossheads

trolled by a right and left screw and wheel *W*. The top section is placed over the crosshead shoe resting on levers *LL* and between pins *NN* and N_1N_1, to grip the sides of the top section, holding it central with the shoe and at the proper

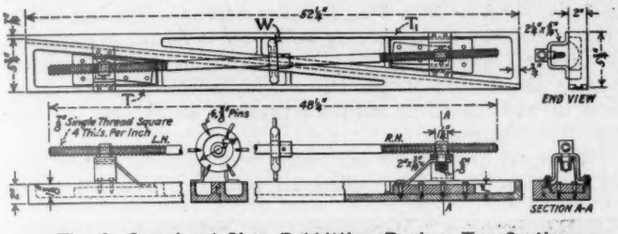


Fig. 3—Crosshead Shoe Babbitting Device—Top Section

height. The openings at the ends of the shoes are plugged with clay and the babbitt poured, in this case also giving a smooth, accurate job which does not require subsequent machining.

Scrap Reclamation*

By L. C. H. Weidman
Railway Service and Supply Corporation, Beech Grove, Ind.

The rolling of scrap iron and axles at Beech Grove is done on an Ajax Type B reclaiming mill in the following manner. Iron rods from ½ in. to 1¼ in. in diameter are cut in lengths 24 in., 28 in., 30 in. and 36 in. long, straightened at the scrap yards and delivered to storage yard at the forge shop. Iron arch bars, transom plates, and other flat pieces of iron are sent to the forge shop where they are sheared up in lengths 4¾ in. long and then sent to the scrap bin at the mill where they are made into bundles about 4¾ in. square, 24 in., 28 in., 30 in. and 36 in. long. These bundles are made by laying the bottom layer of rods the length of the bundle. Next there are two layers of flat scrap laid on the rods with the joints broken. The top is then made of rods the same as the bottom. The bundles are then tied

Rod Size	A
½" x ½"	24"
⅝" X 1"	28"
1¼" X 1¼"	30"
1½" X 1½"	36"

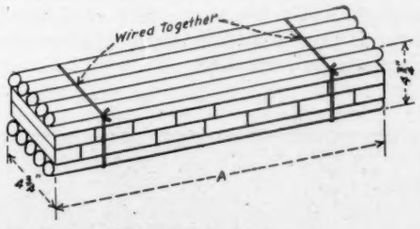


Fig. 11—Method of Bundling Scrap

together with two pieces of No. 8 iron wire. The object of having these bundles various lengths is to keep the rods rolled the length of our straightening bed.

A sketch of a bundle and table of sizes of iron rolled from the different lengths of bundles are shown in Fig. 11. These bundles are put into the furnace and brought up to a welding heat, passed through the roughing and finishing rolls and then go to straightening bed to cool.

We have two four-door furnaces, one on each side of the mill. In charging we generally charge 24 bundles to each furnace. Since the first of the year we have been working two shifts at the mill, 12 hours to each shift, 10 men to each gang as follows: Roller, heater helper, rougher-down, rougher-up, hooker-up, roller helper, straightener, and two bundlers. These men work piece work and are paid 42 cents a 100 lb. for all sizes from ⅝ in. round up to 2 in. round inclusive.

We also reclaim steel in the following way. All scrap steel rods from 1¼ in. up to 2½ in. are sheared in lengths 4 ft. to 6 ft. long. These are piled at the scrap dock until a car-load has accumulated. They are then sent to the forge shop and rolled in steel bars from ½ in. to 1¼ in. Ends from steel axles and billets that are too small for other forgings, are forged to 4½ in. square, 20 in. to 30 in. long and rolled in steel bars from 1⅜ in. to 2 in. We also take all the surplus 4¼ in. by 8 in. iron axles, cut them into three pieces and roll them into iron bars from 1½ in. to 2 in. Tire steel is also rolled to make superheater bolts and pinch bars.

The following is the monthly report for three months showing the cost of operation, the iron rolled, and the saving made:

March, 1923

Scrap to furnace, 764,250 lb. at $22.00 N. T.	$8,406.75
Fixed charges on mill and building for housing:	
Interest at 6 per cent per year	189.41
Depreciation and repairs	238.55
Taxes and insurance at 2 per cent	52.72
Labor charge, direct	4,102.98
551 fuel hours at .5625 per hour	309.94
551 power hours at .30 per hour	165.30
Supervision 5.84 per cent of direct labor	231.60
	$13,697.25

Finished Product

Pounds	Description	Price	Amount
191,950	⅝ in. round iron	$2.90	$5,566.55
86,150	¾ in. round iron	2.85	2,455.28
85,250	⅞ in. round iron	2.85	2,429.63
130,800	1⅛ in. round iron	2.80	3,662.40
103,900	1¼ in. round iron	2.80	2,909.20
54,300	1⅜ in. round iron	2.80	1,520.40
53,300	2 in. round iron	2.90	1,545.70
			$20,089.16

Net profit month of March, 1923	$6,391.91
Net profit since April 1, 1918	$74,279.53

April, 1923

Scrap to furnace 604,900 lb. at $22.00 N. T.	$6,895.86
Fixed charges on mill and building for housing:	
Interest at 6 per cent per year	189.41
Depreciation and repairs	238.55
Taxes and insurance at 2 per cent	52.72
Labor charges, direct	3,169.03
429 fuel hours at .5625 per hour	241.31
429 power hours at .30 per hour	128.70
Supervision 5.84 per cent of direct labor	185.07
	$11,100.65

Finished Product

Pounds	Description	Price per cwt.	Amount
184,300	¾ in. round iron	$2.825	$5,206.48
35,650	⅞ in. round iron	2.825	1,007.11
180,950	1⅛ in. round iron	2.775	5,021.36
56,050	1¼ in. round iron	2.775	1,555.39
61,950	1⅜ in. round iron	2.775	1,719.11
33,250	1½ in. round iron	2.775	922.69
			$15,432.14

Net profit for month of April, 1923	$4,331.49
Net profit since April 1, 1918	$78,611.02

May, 1923

Scrap to furnace 571,300 lb. at $17.95 N. T.	$5,127.42
Fixed charges on mill and building for housing:	
Interest at 6 per cent per year	189.41
Depreciation and repairs	238.55
Taxes and insurance at 2 per cent	52.72
Labor charges, direct	2,975.09
478½ fuel hours at .5625 per hour	269.16
478½ power hours at .30 per hour	143.55
Supervision 5.84 per cent of direct labor	173.74
	$9,169.64

Finished Product

Pounds	Description	Price per cwt.	Amount
222,400	¾ in. round iron	$2.825	$6,282.80
107,350	⅞ in. round iron	2.825	3,032.64
120,350	1 in. round iron	2.775	3,339.71
29,100	1⅛ in. round iron	2.775	807.53
47,250	1¼ in. round iron	2.775	1,311.19
			$14,773.87

Net profit for month of May, 1923	$5,604.23
Net profit since April 1, 1918	$84,215.25

The Missouri Pacific has increased its average miles per car per day from 20.84 in April to 31.98 in August. During August the road also established another record by loading locally and receiving from connections 130,810 cars compared with a previous record of 125,347 cars in October, 1916.

*Abstract of a paper presented at the annual convention of the Railroad Master Blacksmiths' Association, Chicago, August 21, 1923.

Acetylene Sludge Ejector

A MEANS for easily disposing of the sludge or residue from an Oxweld acetylene generator has just been installed at the Pere Marquette shops, Grand Rapids, Mich. Originally the sludge was drained from the generators into a concrete cistern just outside the generator building. The cistern is 8 ft. square and 6 ft. deep with an overflow 8 in. square, located about 18 in. from the top. Periodically the sludge was bailed or dug from the cistern and carried away in wheelbarrows over several tracks to a point about 150 ft. away where it was dumped. Aside from the labor required to move the sludge, the overflow for carrying away the excess of water, frequently became clogged and caused trouble.

A cylindrical tank, formerly in use for oil storage was found which was about 6 ft. long and 5 ft. in diameter and was placed in the cistern. The 2-in. drain from the generators was fitted with a gate valve and connected to the bottom of the tank and carried out under the tracks to the dump. A ¾-in. connection was also brought to the top of

Sluge Ejector Used at Pere Marquette Shops

the tank from the air line and a relief valve provided at the top of the tank. This valve is normally open. When the tank is nearly full of the sludge, the relief valve and the gate valve in the drain are closed. The air is turned on and the sludge is blown out through the outlet in most effective fashion. A water connection is also provided for occasional flushing the tank and the outlet pipe.

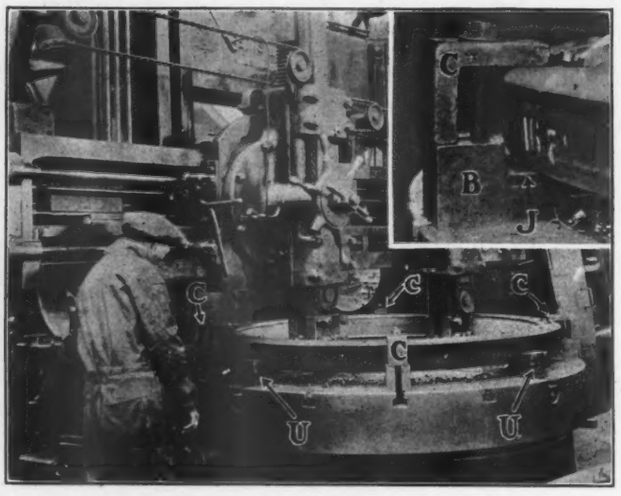
Boring Mill Clamps

THE set of boring mill clamps, shown in the illustration, is designed especially to hold driving wheel tires while being bored for the fit on wheel centers. These clamps are also sometimes used for holding boiler front rings and are notable for the ease with which they are adjusted and the rigid grip which they provide on the parts being turned or bored.

The boring mill illustrated is provided with four universal chuck jaws (two of which are shown at *U U*) for centering the driving wheel tire quickly and accurately. These jaws were originally designed to hold the tire against slipping under heavy cuts but proved inadequate for this purpose, and, realizing the danger of slipping, the operator was compelled to use relatively low speeds and small feeds.

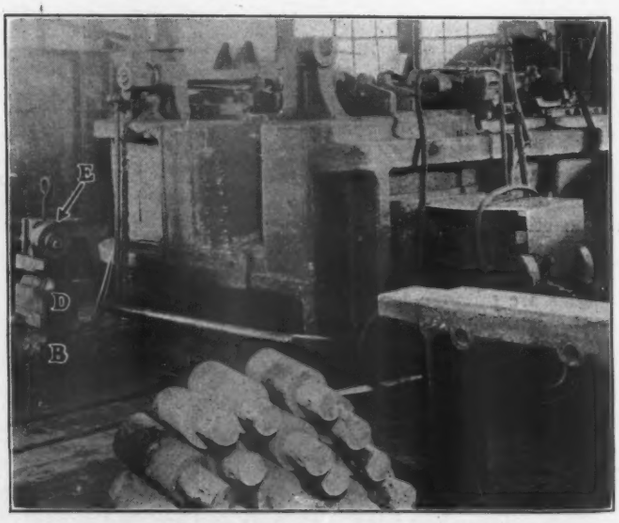
Makeshift clamps applied in addition to the four universal vise jaws also proved ineffective and as a result four special clamps *CCCC* have been provided as illustrated between the universal chuck jaws. They practically eliminate all possibility of the tire or boiler front ring breaking away from the table under the heaviest cuts which the machine can take. Since the installation of these clamps, the boring mill table has been speeded up as fast as it can go, namely, 2 r.p.m. with the controller handle at the last notch. The tire shown on the boring mill table is 56 in. in diameter, so that at a speed of 2 r.p.m., the surface speed of the cutting tool is about 34½ ft. per min. This is considerably in excess of what could be obtained previous to the use of these auxiliary clamps.

While no drawing of the clamp is available, a good idea of its proportions and construction can be obtained from the



Special Clamps Provide a Rigid, Reliable Drive

insert in the upper right corner of the illustration. The tire rests on a forged steel base piece *B* provided with two steps as shown to take tires of varying diameter. The substantial right-angle clamp *C* rests on the tire and base piece *B*, both the clamping unit and tire being held firmly to the boring mill table by a large T-head bolt. The tire rests directly on a hardened steel jaw *J*, provided with teeth for driving in a clockwise direction. It is obvious that a rigid, reliable drive is provided to the driving wheel tire by means of this clamping arrangement.



Wrist Pins with Threaded Ends Roughed Out on Turret Lathe and Hole for ¼-in. Flat Cotters Are Punched in One Heat and One Operation by Dies B, D and E in the 3-in. Forging Machine Illustrated—Billerica Shops of the Boston & Maine.

Steel Treaters' Convention at Pittsburgh

Fifth Annual Convention Notable for Record Attendance and Exhibitions; Live Technical Sessions

THE American Society for Steel Treating held its fifth annual convention at Pittsburgh, Pa., October 8 to 12 inclusive, and in attendance, interest and size of the exhibition this convention was far ahead of any previously held. The registered attendance was about 1,500 of a total membership of over 2,700. Great interest was shown in the technical sessions which were well attended and followed by valuable discussion of theoretical and practical points brought out in the papers. Special sessions were held on lathe tools and steel hardness, carburizing, welding and tool tempering, heat treated forgings, hardness testing, and general subjects with a special roundtable meeting on standards.

The following officers were elected for the ensuing year: President, G. K. Burgess, Bureau of Standards, Washington; second vice-president, R. M. Bird, Bethlehem Steel Company, Bethlehem, Pa.; treasurer, Dr. Zay Jeffries, Aluminum Company of America, Cleveland; director for two years, J. F. Harper, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

One of the most interesting of the sessions was that on lathe tools and steel hardness in which the members listened to papers by prominent authorities on lathe tool performance. One of these papers of particular interest to railroad machine shopmen was on "The Effect of Heat Treatment on Lathe Tool Performance and Some Other Properties of High Speed Steels" by H. J. French, Jerome Strauss and T. G. Digges.* This complete paper will be found in the September Transactions of the American Society for Steel Treating. The conclusions drawn in the paper are presented in full below.

Conclusions Regarding Effect of Heat Treatment on Lathe Tools

One of the outstanding features developed in this investigation is the importance of the time factor in the heat treatment of high-speed steels. Special emphasis is placed on this as the customary methods of treatment adopted by the industry in general include accurate control of temperatures in hardening but leave the time to the judgment of the operator. While excellent results have been obtained in many respects under such conditions it is improbable that anyone can so regulate operations day after day, by observing the appearance of tools or "sweating" produced in hardening, that desired uniformity in results can be obtained in all cases. Accurate control of both time and temperature with suitable instruments is necessary to guarantee consistent results.

The tests made also throw interesting light upon several factors to be considered in the selection of steels for specific service. It has been shown that high-tungsten steels require higher hardening heats to produce maximum endurance than do the steels low in tungsten and that the addition of cobalt raises the required hardening temperature in both types and thus increases the oxidation obtained in heat treatment. However, the former are not as brittle as the latter.

When brittleness is to be avoided but oxidation is unimportant the high tungsten-cobalt steel has a decided advantage over the other three for its endurance is much greater than the two steels without cobalt and it is not nearly as brittle as the low tungsten-cobalt type which has only slightly better average endurance at the highest cutting speeds.

The low-tungsten steels with or without cobalt additions are to be preferred when brittleness is unimportant and the tool can be well supported but severe oxidation is to be avoided. While the low tungsten-cobalt steel *A* in the Table requires a somewhat higher temperature than the steel *C*, which is cobalt-free, its endurance is somewhat greater. However, when the hardening temperature for the low tungsten-cobalt steel *A* is reduced to that recommended for the low tungsten-high vanadium steel *C* both have more nearly comparable endurance. This is indicated in the diagram and substantiated in tests contained in a previous report.

It is more difficult to point out decided advantages for any one of the four steels when maximum tool endurance and minimum oxidation and brittleness are all required. The choice, under such conditions, would depend upon the relative importance of, and quite probably be a compromise between the several factors considered.

There is evidently no one steel which meets all requirements of service for each has special advantages and disadvantages. The addition of cobalt to high-speed steels permits the use of higher hardening heats and so imparts a greater cutting capacity but does not change the characteristics of the two basic types, namely, low tungsten-high vanadium and high tungsten-low vanadium steels.

The endurance of high-speed steels subjected to the severe service described in the first two sets of tests was affected to a relatively small degree by variations in tempering subequent to hardening. The frictional temperatures produced were not less than 1,400 deg. F. which is higher than that required to decompose the martensitic groundmass of the hardened steel. The degree of red hardness was therefore considered a function of the quantity and characteristics of the constituents formed at the high heats used in hardening (2,200 to 2,500 deg. F.), as indicated by thermal analysis, and largely independent of the properties of the groundmass.

If this is so the question naturally arises why tools which will cut under frictional temperatures of 1,400 deg. F. would be entirely ruined if first tempered at this same temperature. While no final answer can be given, there are a number of important differences between tempering a tool and subjecting it to service at such high temperatures. In the first place the ordinary method of tempering consists in exposing the hardened steel to this temperature for a longer time than any of the tools would cut. Also it is well known that pressure as well as temperature markedly affects many atomic or molecular reactions. Temperature alone is applied to the

*The authors of the paper are H. J. French, physicist, Bureau of Standards, Washington; Jerome Strauss, material engineer, United States Naval Gun Factory, Washington; T. G. Digges, assistant physicist, Bureau of Standards, Washington.

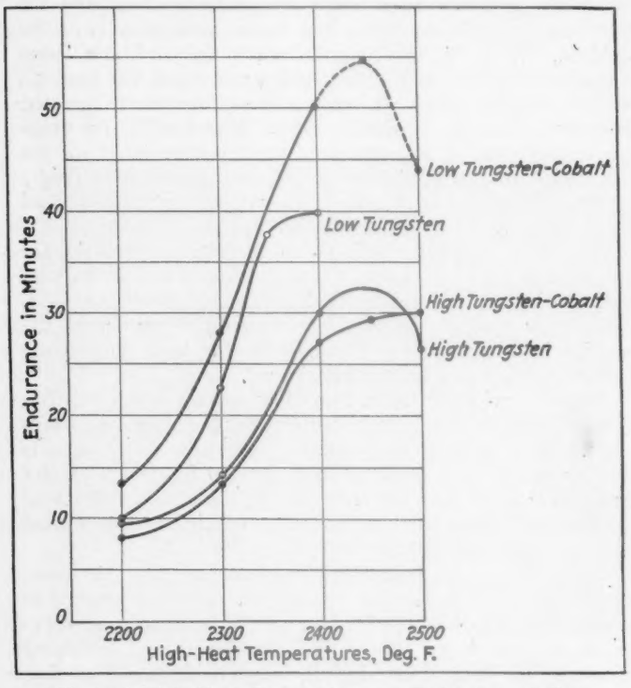
CHEMICAL COMPOSITION OF THE HIGH-SPEED STEELS TESTED AND PRELIMINARY ANNEALING TREATMENTS USED

Steel No.	Type of Steel / Steels used in lathe tests	Chemical composition, per cent C	Cr	W	V	Co	Mn	P	S	Si	Ni	Annealing treatment used
A	Low tungsten-cobalt	0.65	4.00	13.92	1.49	3.63	0.44	0.013	0.019	0.17	0.06	1,600 deg. F.—3 hr.—furnace cool
B	High tungsten-cobalt	0.68	3.67	17.97	0.73	3.06	0.42	0.013	0.016	0.15	0.04	1,600 deg. F.—3 hr.—furnace cool
C	Low tungsten-low vanadium	0.68	4.37	13.91	1.64	0.09	0.42	0.022	0.013	0.16	0.12	1,600 deg. F.—2 hr.—furnace cool
D	High tungsten-low vanadium	0.64	3.93	18.33	0.85	None	0.39	0.017	0.017	0.06	None	1,600 deg. F.—3 hr.—furnace cool
	Steels used in transverse tests and for observations on dimensional changes, etc.											
Z	Low tungsten-high vanadium	0.74	4.05	12.58	1.67	None	0.27	0.029	0.018	0.09	Trace	1,600 deg. F.—2 hr.—furnace cool
CC	High tunsten-cobalt	0.68	3.47	18.46	1.01	3.48	0.11	0.014	0.015	0.05	None	1,600 deg. F.—2 hr.—furnace cool
H	High tungsten-low vanadium	0.62	3.92	17.67	0.70	None	0.28	0.015	0.020	0.12	Trace	1,600 deg. F.—2 hr.—furnace cool
A 34	"Die steel"	0.56	2.21	13.80	0.98	....	0.42	....	....	0.20	....	Tested after various preliminary treatments.

steel in tempering whereas in cutting metals both high temperature and pressure are obtained. It is therefore conceivable that the pressure tends to retard the reactions which would take place at a given temperature and so tend to prevent complete reversal of the changes produced in the hardening or at least make them take place so slowly that the tools will cut for a definite length of time at such high heats before failure occurs.

The principal conclusions to be drawn from the described tests may be summarized as follows:

(1) The endurance of high-speed steels is affected to a marked degree by the high heat temperature used in hardening and rises rapidly with increase above 2,200 deg. F. However, a point is finally reached where a further temperature rise is no longer attended by a commensurate increase in the endurance and if high enough heats are employed a



Effect of High Heat Temperature on Endurance of Four High-Speed Tool Steels

decrease will be observed coincident with a partial melting of the steel. Under otherwise fixed conditions there is therefore a high heat temperature which results in maximum endurance but this varies with composition. It is higher in the 18 per cent tungsten than in the 13 per cent tungsten steels and is raised in both types by the addition of 3 to 5 per cent cobalt.

(2) The best hardening temperatures for the four main types of high-speed steel, to be used as lathe tools under severe service, are considered to be about as follows:

2,350 deg. F. for low tungsten-high vanadium steel
2,400 deg. F. for high tungsten-low vanadium and low tungsten-cobalt steels
2,450 deg. F. for high tungsten-cobalt steel

These temperatures are a compromise between several factors including tool endurance and brittleness.

(3) The endurance of high-speed steels is likewise dependent upon and, within limits, increases with the time at high heat. In tests made with high tungsten-low vanadium steel, tools held 3 min. at 2280 deg. F. had superior endurance to those held 50 sec. at 2,400 deg. F. but were not as good as those subjected to the latter temperature for 1½ min. Therefore for consistent results both time and temperature should be controlled by suitable instruments.

(4) High-speed steels subjected to the severe service described were found to have endurance characteristic of the high temperature treatment used in hardening and this was not modified to any great degree by any subsequent tempering up to and including 1,100 deg. F. However, the higher the tempering temperatures the tougher did the steel become. The most important reason for tempering, in this case, is not increased endurance but decrease in brittleness.

(5) Length shrinkage, or expansion, may be produced in hardening a high-speed steel from a given temperature, if this is not too high, by varying the treatment prior to hardening. This includes both preliminary annealing and the manner of heating for hardening. However, the higher the quenching temperature and the time at high heat, within limits ordinarily encountered in commercial heat treatment, the greater will be the expansion or, under certain conditions, the less will be the shrinkage. Likewise tempering subsequent to hardening may be used to reduce original length shrinkage or expansion but the final length will approximate the original only in certain cases. The tempering which will produce this ideal condition will vary widely in a given steel depending upon the previous history of the samples but in no case is it possible to completely compensate for hardening changes in two dimensions.

(6) In a series of tests on nickel steel forgings in which the cutting speed was varied from about 45 to 70 ft. per min. high-speed steels containing about 3.5 per cent cobalt had much greater endurance than the plain chromium-tungsten-vanadium steels. Under the most severe service the low tungsten-cobalt type was superior to the high tungsten-cobalt steel but at the lowest speeds both had comparable endurance. Comparisons of the four steels tested when based on the breakdown test, showed the following order of superiority:

	Per cent
Low tungsten-cobalt steel	98
High tungsten-cobalt steel	90
Low tungsten-high vanadium steel	68
High tungsten-low vanadium steel	47

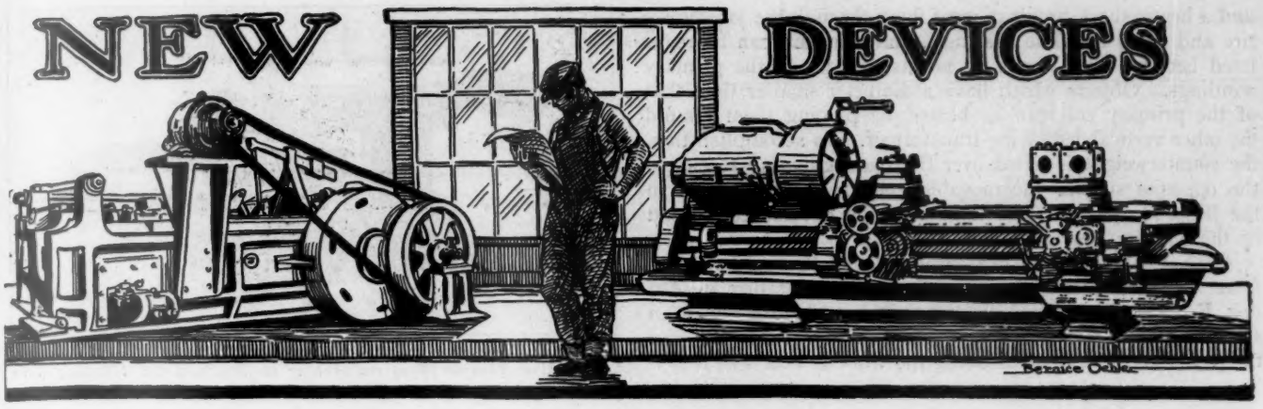
(7) Low-tungsten steels, with or without cobalt additions are more sensitive to heat treatment than the high-tungsten types. They are more brittle when hardened for maximum endurance but require lower hardening temperatures than do the corresponding high-tungsten steels. These features, in addition to comparisons of endurance, must be considered in selecting steels for particular service. No one type of high-speed steel meets all requirements but each has its advantages and disadvantages.

(8) Both the "Breakdown" and "Taylor" tests have limitations and cannot wholly replace the method of using tools in the shop to determine just what they will do. However, much worthwhile information of practical value can be obtained in relatively short time by careful interpretation and correct application of results obtained by either test.

(9) In normal shop practice so-called "flaky" steel may be produced through the hardening of long lengths of lathe, planer and shaper tools followed by dressing operations in which only part of the previously hardened steel is heated to annealing temperatures which would ordinarily prevent its occurrence. As "flaked" steel is brittle and showed a tendency toward erratic results its production is to be avoided.

(10) Prevention of "flaky" fractures in ordinary high-speed steel in heat treatment is much more simple than elimination and may be accomplished by annealing between successive hardening treatments. In no case, when once produced, was complete elimination effected by annealing alone though certain complicated treatments left mere traces of this structure upon rehardening. However, combined forging and annealing completely removed severe "flake" in all steels tested. In general the greater the reduction in forging the lower was the annealing temperature required for a cure (within limits).

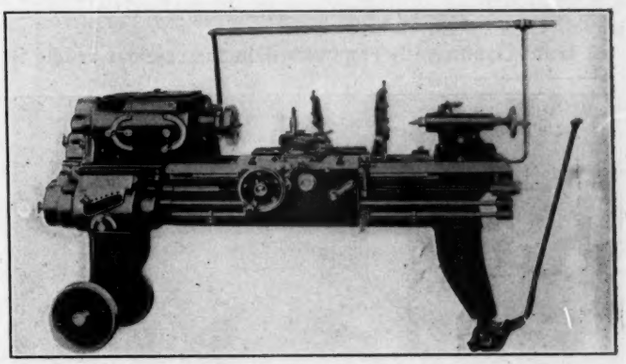
(11) High tungsten-low vanadium steels offered the greatest resistance to the formation of "flake" and likewise to its elimination when once produced.



Portable Geared Head Lathe

A 15-IN. portable geared head lathe that can be transported to any place in the shop has been placed upon the market by the Rockford Tool Company, Rockford, Ill. This lathe is patterned after the 14-in. Sundstrand tool room lathe manufactured by the same company, except that the motor is mounted directly on the headstock. The machine is mounted on three solid iron wheels, as shown in the illustration, two under the headstock end and one under the tailstock. It is convenient to operate. In its design special attention was devoted to reducing the number of controlling levers.

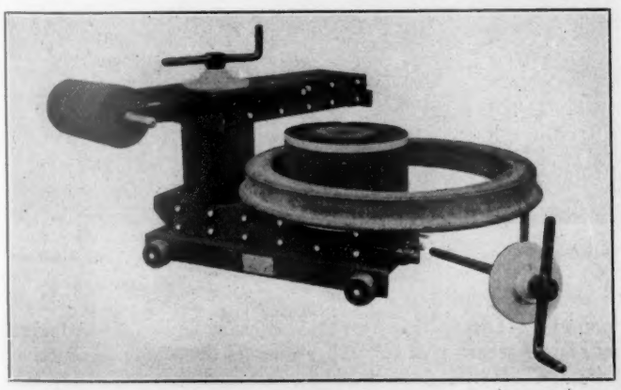
The bed is 13½ in. wide and well braced. The distance between centers, when the tailstock is flush with the end of the bed, is 32 in. The swing over the carriage is 8¾ in. The carriage has a full length bearing surface on the bed, which is cross-grooved for oil channels. The ends are provided with bronze vee wipers with felt inserted for cleaning and oiling the vees. The feeds are from 6 to 368 per in. The tool post takes a tool from ½ in. to 1 in. The driving shaft pulley is 10 in. by 3¼ in. and the standard driving pulley speed is 350 r.p.m. There are 12 spindle speeds available. The net weight of the lathe with a 6-ft. bed is approximately 2,250 lb.



Sundstrand Portable Geared Head Lathe

Swiss Portable Electric Tire Heater

A SPECIAL portable transformer for heating wheel tires electrically has been developed by the Ateliers De Construction Oerlikon, Oerlikon, Switzerland. The apparatus is suitable for the heating of tires, gears, shrink rings, etc.; which work is generally done in an oil fire and occasionally by means of a gas, coal or coke fire, the tire or gear being heated until its diameter is expanded sufficiently to permit the shrinking of the same onto the wheel center. A disadvantage of the usual method as compared with electric heating is the lack of cleanliness, uniformity of heating and exact and proper heat control. The electrical apparatus has the added advantage that a single machine can be used to heat tires of any diameter.



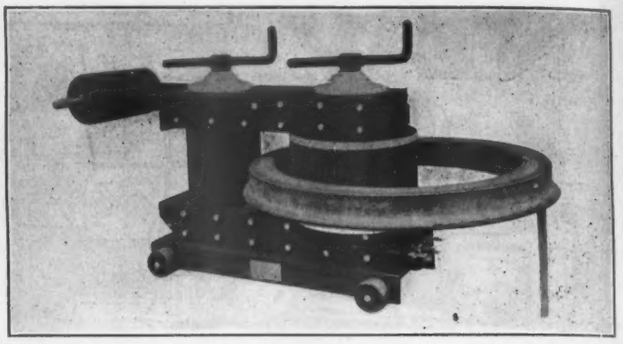
Electric Tire Heater in Position for Applying or Removing the Tire

The device consists essentially of a transformer with a single primary winding. The transformer core has two vertical legs, a permanently connected yoke at the bottom which is mounted on four small wheels, and an upper movable yoke which can be pivoted on either one of the two vertical legs. The primary coil is placed around one of the vertical legs.

When a locomotive tire is to be heated, the movable yoke is swung to one side as shown in Fig. 1, and the tire is placed around one of the vertical legs. The movable yoke is then swung into position as shown in Fig. 2 and the two screw clamps placed in the position shown and tightened so as to effectively close the magnetic circuit. Single-phase alternating current is then connected to the primary coil, the tire then becomes a short-circuited secondary with a single-turn coil

and a heavy short circuit current flows through the locomotive tire and heats it. The heating is uniform and can be regulated between wide limits by means of taps on the primary windings. Objects which have a diameter smaller than that of the primary coil can be heated by placing them around the other vertical leg of the transformer. To accomplish this, the counterweight is lifted over the two tightening screws to the opposite side of the movable yoke from that shown in the illustrations and the left hand screw is removed instead of the one on the right hand.

A 72-in. locomotive tire weighing 1,230 lb. can be raised from a temperature of 63 deg. F. to a temperature of 246 deg. F. in 20 min. This difference in temperature causes an expansion of about 1/10 in. in the diameter of the tire and the power consumption for doing the work is 12.2 kw. hr.



Locomotive Tire on Electric Heater in Position for Heating Tire

Service Tests of Adjustable Driving Box

THE locomotive driving box with adjustable bearings illustrated was designed by J. Murrin, superintendent of shops, and E. J. Brewster, general foreman, Chicago & North Western, and is now manufactured and sold by the Gill Railway Supply Company, Peoria, Ill. This box was described on page 685 of the December, 1922, *Railway Mechanical Engineer*.

A point insufficiently emphasized in the original article is

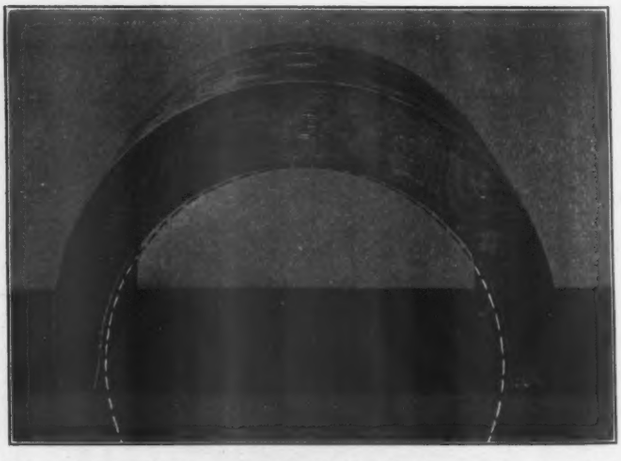
Two Narrow Wedges Operating Vertically Keep the Crown and Quarter Brasses Tight and Two Wide Wedges Take Up Wear on Quarter Brasses and Resist Thrust

that in service the driving box brass wears faster at the hub than at the inner end. It is not unusual to find a difference of 1/16 in. in calipering the outer and inner diameters of the main bearing. When the old type of bearing gets into this condition, it must be rebored or renewed. With the adjustable type bearing this condition can be remedied by removing the quarter brasses and taking a cut off the back of each of them. If the bearing is 1/16 in. too wide on one end, a 1/32 in. cut, tapering down to zero, is taken off each quarter bearing. These quarter bearings are then reapplied and the same main bearing used.

The first box of this design was applied to the left main journal of a Pacific type passenger locomotive, the right main journal being equipped with an old style box at the same time, in October, 1920. Since then the new type brasses have been in service a total of 126,333 miles without renewal, the old style box requiring four new main brasses in the same time. The locomotive makes approximately 25,000 miles between adjustments of the quarter brasses. This form of construction has proved its economy and serviceability by the increased number of applications and at present, there are 155 locomotives equipped with the new style box, with additional installations constantly being made.

While the mechanical features of this box are easy to grasp and the simple construction is an important advantage in its favor, its main claim for extensive adoption on locomotives lies in the economy it promotes. It is said to save between 75 per cent and 90 per cent of the material and labor cost of driving box bearing repairs, also greatly reducing the cost when a bearing must be entirely replaced. The brass fit on this box can be bored on a boring mill in place of being slotted, which is a simpler process, more economical and more accurate. The hub liner can be bored at the same setting. The adjusting wedges and retaining keys on these boxes are interchangeable for all types of locomotives.

Bearing adjustments with this driving box are made easily so there is no need of bearings running with a destructive



This Bearing Was Worn 3/32-in. Wide at the Bottom Axle Position Shown by Dotted Line

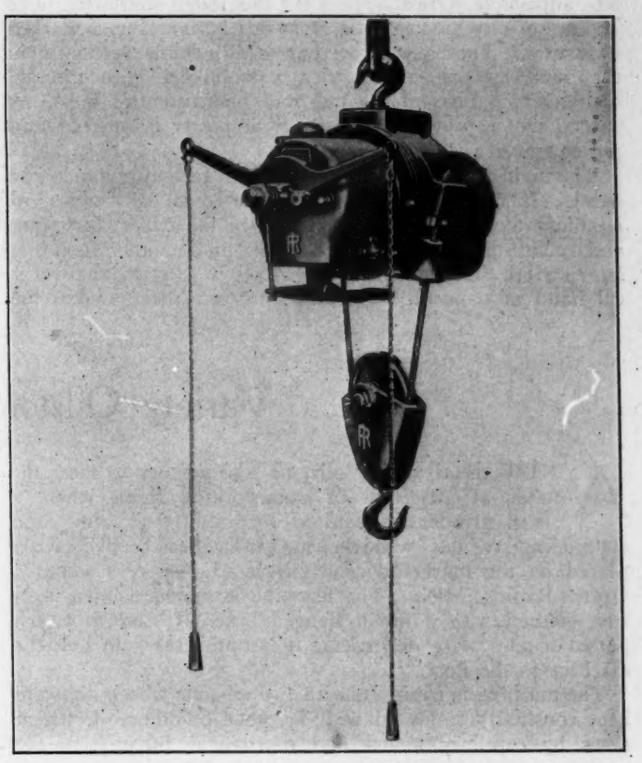
"pound." This pound is not only hard upon the bearings but causes severe jars and vibrations on the whole locomotive structure. While these bearings are comparatively new in locomotive service, quarter brasses have been used for many years on stationary engines for taking up thrust.

Air Motor Hoist of 500 Lb. Capacity

AN air motor hoist of new design, of small size and capacity, is now being manufactured by the Ingersoll-Rand Company, New York. It can lift 500 lb. at the rate of 50 ft. per min. with an air pressure of 80 lb. per sq. in., to a maximum height of 15 ft. It has a net weight of 150 lb. and can operate on an air pressure of from 60 to 100 lb. per sq. in. This hoist is suited for a wide range of service where rapid and economical lifting in the handling of small tools, too heavy for one man to deal with, is desired. It is equipped with an automatic brake which holds the load positively. It works independently of the air supply, thus providing a necessary safety feature in case the air should be disconnected or fail.

A balanced, three-cylinder air motor is used, which operates in either direction and without vibration at any speed or load within the rated capacity of the machine. The hoist differs entirely from direct-acting cylinder hoists and lifts. The latter consist essentially of only the plunger and a case. The Ingersoll-Rand air hoist is equipped with an air motor, which is geared through a mechanical train to a hoisting drum. The throttle graduation hoist insures instant and complete control of the hoist at any speed. A safety stop lever is provided, which closes the throttle and stops the motor whenever the load is raised to the top of the hoist lift.

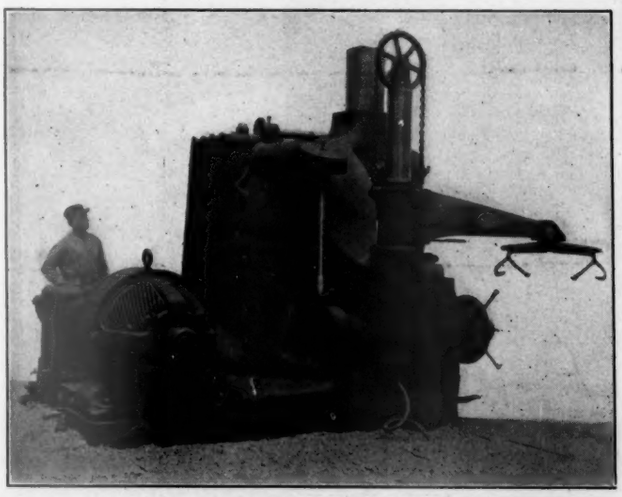
The brake consists of a disk attached to the shaft of the motor, and a brake plunger with a friction face, which is held in contact with the disk by means of springs whenever the hoist is not in operation. It is entirely automatic in its action and therefore requires no attention whatever from the operator of the hoist.



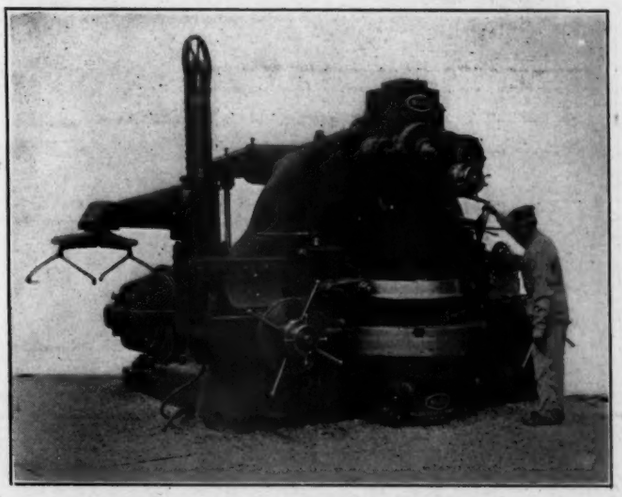
Front View of Ingersoll-Rand Air Motor Hoist

A Vertical Car Wheel Lathe

A NEWLY developed machine tool has recently been brought out by the Niles-Bement-Pond Company, New York, for the purpose of machining rolled or forged steel car wheels. The principal object in designing this machine was to replace a number of the ordinary types of general machine tools heretofore employed in the manufacture of car wheels and thereby speed up production. This machine, styled a vertical car wheel lathe, receives the wheels as they come from the hot working operation. The operations accomplished consist of turning the contour of tread and flange, facing the hub and end on one side, bossing eccentric hubs where such exist, undercutting the rim and scribing the wear line. All these operations are handled simultaneously, with the exception of the last, which is postponed until the wheel is finished. The capacity ranges from 33-in. to 42-in. wheel diameters.



Rear View of Niles-Bement-Pond Vertical Car Wheel Lathe



Vertical Car Wheel Lathe with Wheel in Position for Turning

Some of the operations that the lathe handles are the same

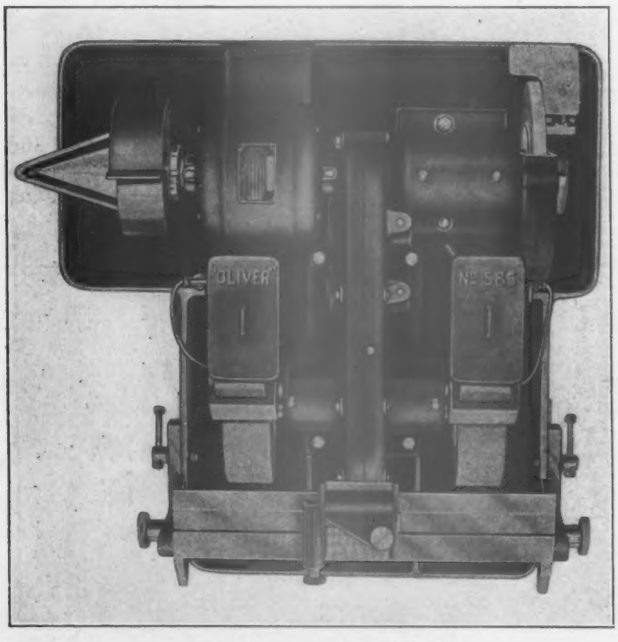
as those ordinarily accomplished on the standard car wheel lathe. The horizontal rotary table and the long square steel bar, adjustable vertically, bear out this rough similarity. The absence of any analogy to a cross-rail is, however, a marked departure. The square tool bar is adjustable vertically in the main housing and carries a toolholder with inserted blades which face off the hub and boss eccentric hubs. A special motor provides this bar with power down-feed and power traverse in both directions.

The main right-hand side head rough turns the flange and tread. It is provided with a power-feed. It carries an auxiliary tool head in which are fitted the tools which face and round the rim and undercut it, and another tool that later scribes the wear line. The tools have cross and vertical hand adjustment. The left-hand side head makes the finishing cut on both flange and tread and it is provided with vertical hand adjustment and power cross feed. The feeds to all heads are independent of each other and all have automatic trips which disengage the feeds at any predetermined point. The main driving gear is a cut spur gear with a 12-in. face twice the diameter of the table. A variable speed motor with a three to one range is direct-connected to the machine. All shaft bearings are provided with sight feed oilers. Handling and set-up time is minimized by the combination of a pneumatic crane with pneumatically operated center jaws which expand inside the center hole of the wheels, and three serrated, quick-acting driver dogs which support and drive the wheel on the table. A roller on the left-hand side head brought into contact with the wheel before chucking serves to center the wheel in place.

Variety Oilstone Tool Grinder

A NEW metal variety oilstone tool grinder to meet the needs of all kinds of woodworking shops where a small grinder is required for rapidly grinding and sharpening various woodworking tools has been recently placed on the market by the Oliver Machinery Company, Grand Rapids, Mich. The machine is mounted on a cast-iron column with a broad flanged base. It can be transported to any place desired, as it is unnecessary to bolt the machine to the floor.

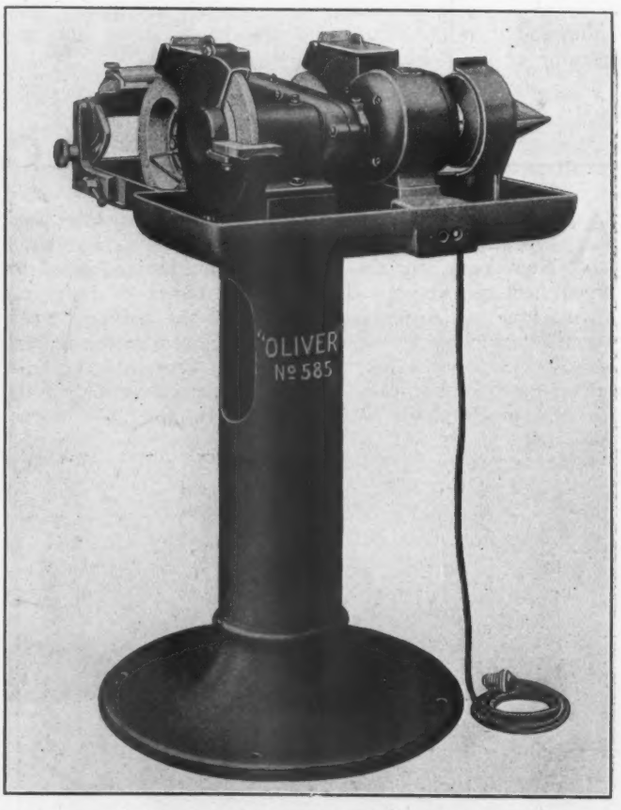
The machine is equipped with two oilstone wheels that are kept constantly saturated with kerosene or other oil, which flows by capillary action and centrifugal force from the center of the stones to the outer surface, thus keeping the pores free cutting. The oilstone wheels are of the cup type and run on ball bearings. One is a coarse grain wheel for rapid abrasion and the other is of a fine grain for putting a smooth, keen edge on the tool. These wheels are 8 in. in diameter with a 2-in. face and run at a speed of 300 r.p.m. Both of the wheels are well guarded. They are arranged with a table which acts as a tool rest. Plane bits, chisels and similar tools can be ground by fastening them in the toolholder, which has a micrometer feed.



Top View of Oilstone Tool Grinder

Directly mounted on the motor shaft is a cone and a leather stropping wheel, 6 in. in diameter with a 2-in. face, which runs at a speed of 1,800 r.p.m. The cone is useful for the inside of curved edges, irregular shaped tools, etc. On the other end of the same shaft is a general utility grinding wheel with an adjustable tool rest.

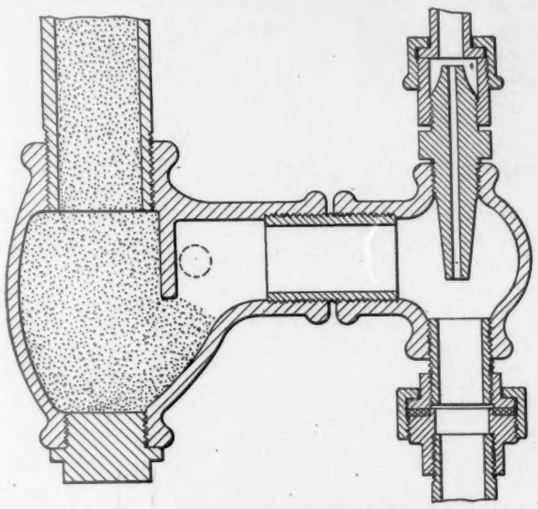
The machine is so arranged that four operators can use it at one time. All gears and bearings are fully enclosed with cast-iron covers. The motor is fully enclosed, operates at 1,800 r.p.m., either alternating or direct current, 110 or 220 volt, and may be run from an ordinary lamp socket.



Oliver Variety Oilstone Tool Grinder

The Pratte Vacuum Locomotive Air Sander

A LOCOMOTIVE sander operated in somewhat the same manner as an injector or vacuum pump is being manufactured by the Pratte Vacuum Air Sander Company, Denver, Col. It is simple in construction and can be applied to any sand box. The construction permits it to handle very coarse gravel or the finest sand. Moisture in the air pipes appears to have no ill-effect on its successful operation, and unlike most sanders it can throw from a few grains of sand to the full capacity of the pipe.

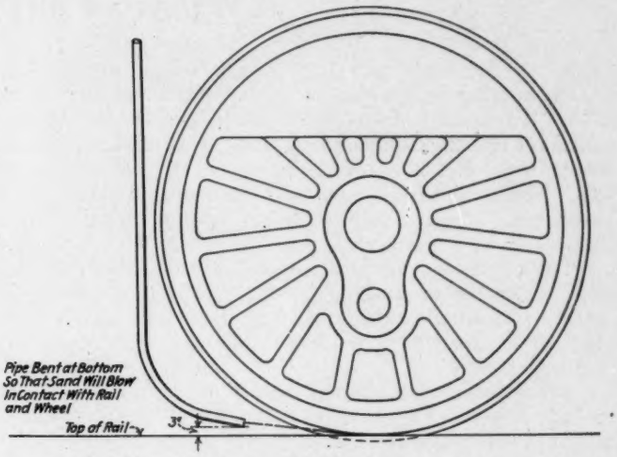


Sectional View of the Pratte Sander Showing the Relation of the Trap and Ejector Nozzle

The sand from the box drops into the trap of the sander by gravity. Thence it is drawn into the delivery pipes by air passing through air nozzles located in the top of the vacuum chambers. A force sufficient to deliver sand anywhere required is created by vaccum and by taking in air through the vacuum holes in the body of the sander. The force at which the sand travels leaves practically no sand in the long runs of horizontal pipe when the air valves are closed. This eliminates stopping up by accumulating sand.

The atmosphere pipes, screwed into the body of the sander, are only used to keep snow or rain from coming in contact with the sand. The 1-in. plug in the bottom of the device is for removing rock, waste or other substances that may not be drawn through into the delivery pipes.

A rod is passed through the body of the sander into the box to loosen the sand when it becomes baked and hard. By regulation of the air valve, considerable sand can be saved and in times of severe weather it prevents the ends of the delivery pipe from being stopped up with snow and ice.

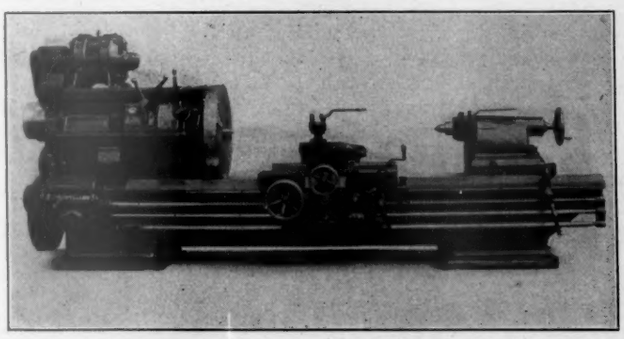


Relation of the Sand Pipe to the Driving Wheel and Rail

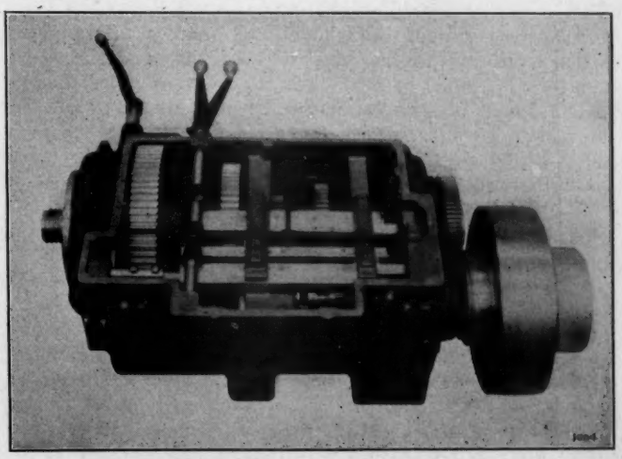
Improved Heavy Duty Lathes

THE R. K. Le Bond Machine Tool Company, Cincinnati, Ohio, has recently placed on the market an engine lathe in which has been incorporated a number of new features. The lathes of the new design range in sizes from 25 to 36 in. Special attention has been given in the design to provide rigidity of all parts with the increase in driving power. The lathe has 16 spindle speeds, selective in geometric progression, obtained with two levers.

All the gears are of chrome nickel alloy, heat treated and hardened, with stub form teeth. They are provided with multiple keyways which are broached from the solid metal. The shafts have multiple hobbed splines. There is a separate feeding rod for driving feeds, and provision has been made for cutting the special coarse leads or metric threads by applying gears at the end of the box.



Front View of the LeBlond 30-Inch Lathe



Interior View of Headstock of LeBlond 30-Inch. Lathe

The head stock is of massive construction and is automatically oiled, the lubricant being pumped to all of the bearings and the gears running in an oil bath. The motor is mounted on top of the head stock and the drive is transmitted through a motor pinion and intermediate gear to the broad faced gear that replaces the driving pulley. The full number of mechanical speed changes are retained in the head stock. The manufacturers also offer this lathe with double motor drive, in which case the motor is mounted on a plate attached to the base of the lathe. By this method the drive is transmitted through a high speed, endless, double leather belt to the driving pulley. A tightener pulley, mounted on roller bearings, is provided to increase the contact area of the belt on the pulleys.

The weight of the lathe, with a 10-in. bed, is 13,200 lbs. The distance between centers is 2 ft. 10 in., with a steady rest capacity of 10½ in. The driving pulley runs at a constant speed of 500 r.p.m., and has a multiple disk clutch and brake running in oil. The spindle, which is 4¾ in. in diameter by 3¾ in. long, is started and stopped from the front of the headstock. In order to provide for the requirements of special work, a turret can be applied to the carriage. A turret tool post and a taper attachment are also among the attachments available.

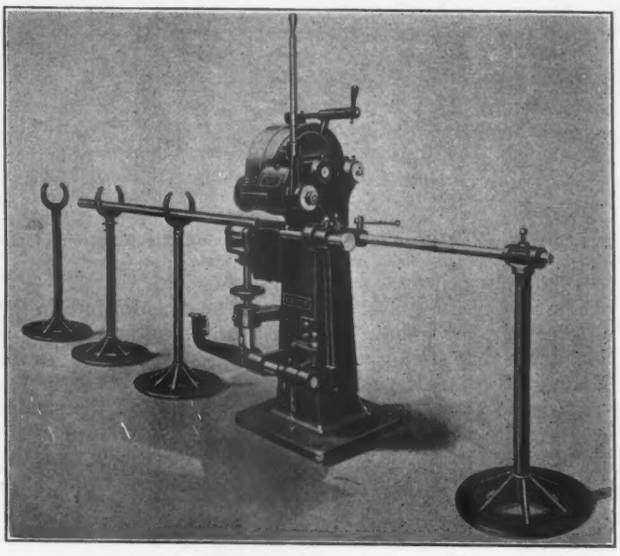
A Heavy Duty Roller Pipe Cutter

A PIPE cutter, in which is embodied a number of important features found to be essential for heavy duty, has been placed on the market by the Geist Manufacturing Company, Waynesboro, Pa. The machine is made only in the No. 2 size and is compact and rigid in design. All spindles and shafts are ground and run in bronze bushed bearings. The gears are enclosed, but are accessible at all times.

The cutter is made from tool steel and heat treated to give maximum wearing qualities. It can be reground when dull. The cutter shaft bearing is provided with an adjustable cap on the cutter side for taking up any wear which may occur.

The rollers, made from tempered tool steel, are carried in roller bearings and can be adjusted to the different sizes of pipe. This adjustment is obtained by means of a hand wheel located just below the rollers. The lever and the pedal can be positioned to suit the operator. Their movements are limited by an adjustable stop. A small cage of rollers for ⅛-in. to ⅜-in. pipe can be attached to the large cage without removing the regular rollers. The cage which supports the rollers is elevated to the cutter by a cam operated jointly by a pedal and a lever. The sliding surfaces of the cage are protected from scale and dirt by flexible guards.

The length gage is adjustable to different sizes and lengths of pipe. It will gage lengths of pipe up to and including four feet. Parts coming in contact with the revolving pipe are hardened to resist wear. The gage arm is a heavy casting.



View Showing Geist Roller Pipe Cutter With Pipe in Position

Tests of Corrosion-Proof Cement

EXPERIMENTAL investigation conducted by G. F. Gebhardt, consulting engineer, Chicago, of the corrosion-proof cement made by Robert M. Lucas Company, Chicago, brought out a number of important facts pertaining to the properties of this material. The tests were planned to show the action of the material under all conditions of service likely to be met in railway practice. They were grouped under three general headings; namely, chemical, physical, and electrical. Tests also were made with other cements for the purpose of comparison.

The chemical tests continued without interruption for more than a month. The object was to determine the resisting qualities of this cement as a protective coating against acids, alkalies and gases, hot or cold. The results showed that the stronger acids had some action on it, but the resisting qualities were good. Weak acids and alkalies, moisture, smoke, furnace gases and fumes had practically no effect. Physical tests were run for the purpose of determining the behavior of the material under alternate heating and cooling, and also its value as a heat insulator. An iron plate, ⅛ in. thick, was covered with Lucas cement and allowed to dry thoroughly. It was then heated to a temperature of 140 deg. F. during the day and allowed to cool to 65 deg. F. during the night. This treatment was continued for 30 days and the coating watched closely for warping, curling, or cracking. Nothing of the sort was noted, the material remaining in the same condition as when applied.

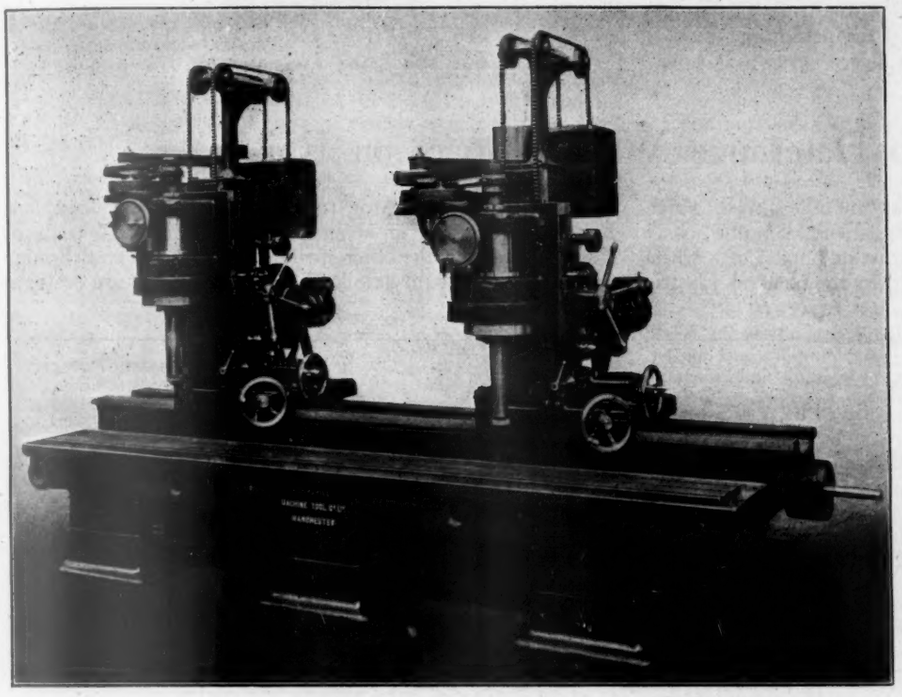
Heat conductivity tests were made on an iron plate, first bare and then covered with Lucas cement. The test outfit used was the hot box conductometer, commonly known as the "postal" box. The results of these tests showed that a coating of Lucas cement 1/16 in. thick on an iron plate will reduce the heat flow through it by 36 per cent. This is an important factor wherever it is desired to reduce the flow of heat into a car having metal sides, ends or roof. The cement tends to keep the surface at a higher temperature and condensation, or sweating, is generally reduced.

In the electrical tests, it was shown that the cement had no measurable galvanic action with metals. This test was run to show whether local actions due to the galvanic or battery action, which sometimes occurs between different parts of a structure, especially in the presence of moisture, can be minimized. The corrosion tests showed that there was a high resistance to electrolytic action.

Double-Spindle Vertical Hole-Grinding Machine

ONE of the interesting machines developed for railroad shop use by the Churchill Machine Tool Co., Ltd., Manchester, England, is the double-spindle vertical hole grinder illustrated. This machine corresponds with the duplex rod boring machine, familiar in American railroad shops and, like it, is used on rod work, being adapted to truing holes which have become elongated and out-of-round in service. The grinder is especially adapted for this work because it trues the holes quickly, accurately and with the removal of the least possible amount of metal.

The machine illustrated is provided with two spindles having planetary motion and will grind holes up to 12 in. long. The machine is by no means limited to rod work, however, since each head can be independently operated for other grinding work. The grinding heads are each provided with hand adjustment, both lateral and transverse for positioning the spindles. The grinding wheel spindles are provided with planetary motion, adjustable while grinding is proceeding. Each spindle head has automatic vertical reciprocating travel on the column, adjustable for length of stroke.



Churchill Model U H Double-Spindle Hole Grinder Adapted for Rod Work

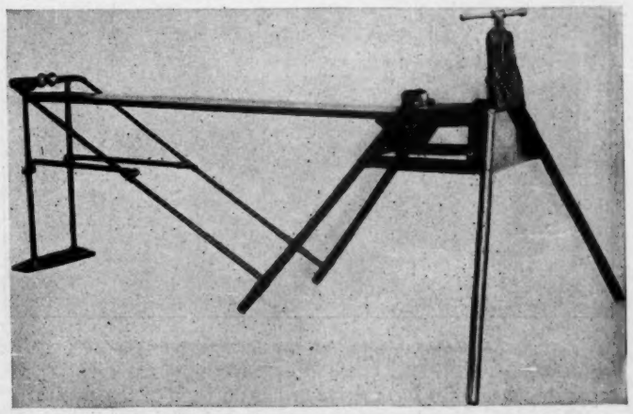
The eccentric stroke of the grinding spindles is from zero to 1¾ in. The maximum diameter of the hole to be ground is, therefore, the wheel diameter plus 1¾ in. The automatic vertical traverse of the spindle head is 12 in. and the cross adjustment 6 in. The maximum distance between spindle centers is 140 in. which can be made longer if required. The minimum distance between spindle centers is 33 in. The working surface of the table is 144 in. by 12 in. With belt drive from a countershaft, 14-in. pulleys are used with 3½ in. belt. A countershaft speed of 460 r.p.m. is recommended. With motor drive a 7½-hp. constant speed motor, running at 650 to 750 r.p.m., is recommended. The approximate net weight of this double-spindle hole-grinding machine is 13,440 lb.

A Portable Vise Stand and Pipe Bending Tool

A PORTABLE vise stand and pipe bender has been developed by H. B. Martin & Sons, Owensboro, Ky., which is built of No. 16 sheet iron, riveted in place and braced at the corners with angle irons, which serve also as sockets for the four supporting legs.

The legs are steel tubing, long and strong enough to support the frame at a convenient height for use and at the same time extend outward sufficiently to brace the stand against upsetting, tilting or skidding without requiring other support, whether upon a floor, sidewalk or the ground. The stand is equipped either with a hinge or chain vise, as desired, which is fixed rigidly to the top of the frame at one end in such a position that short nipples can be threaded without injury to the hands. At the end of the frame a device is provided which serves both as a guide and a rest for pipe while it is being cut or threaded and as a means of bending pipe or conduits from ⅛ in. to ¾ in. in diameter. The latter device is always ready for instant use without adjustment and is said to enable bends to be made not only free from kinks but at the exact point in the pipe where they are wanted.

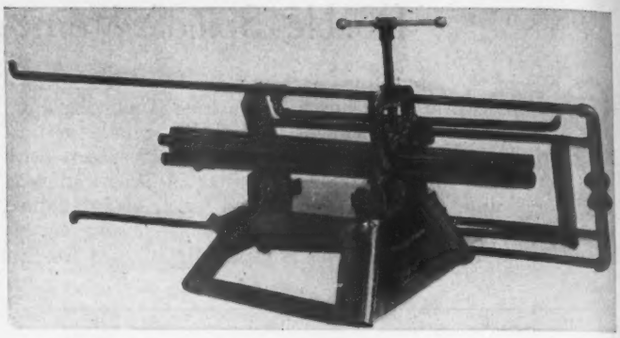
When it is desired to dismantle the equipment the legs are simply pulled out of the sockets and fastened in the vise, whereupon a handle is provided in a convenient position with which to carry the outfit. Since the sides of the frame are open, with a brace across the bottom of these sides, the frame also provides a convenient rest for the pipe tools where oil from the stocks will drain off without running down the



The 4½-In. Capacity Stand Set-Up with a Rear Support for Handling Full Lengths of Pipe

handles. The equipment of the size and capacity described weighs only 50 lb., is said to take but one-half minute either to assemble or to dismantle and can be set up in a 6-ft. by 8-ft. space.

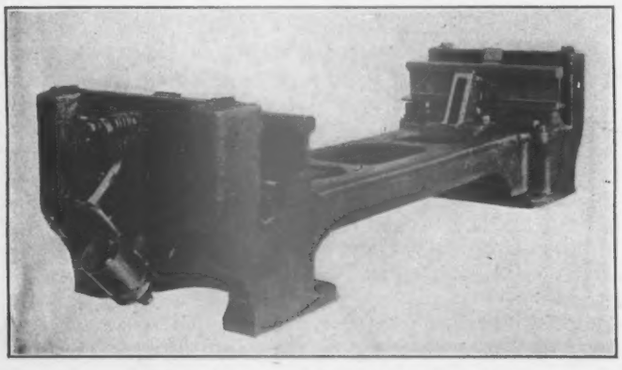
The outfit described is built to handle pipe ranging from ⅛ in. to 2½ in. in diameter. For pipe up to 4½ in. in diameter a heavier stand is provided with which is also furnished a rear support, permitting full length of pipe to be used without tilting the stand. A roller on this rear support, aside from keeping the correct alinement, enables one man to move full lengths of pipe forward or backward at will. With this equipment the bender capacity is increased sufficiently to handle one-inch pipe with ease. The weight of this machine, complete with a four-inch hinge vise, is 172 lb. and with a chain vise, 156 lb.



The Large Size Stand Assembled for Transporting

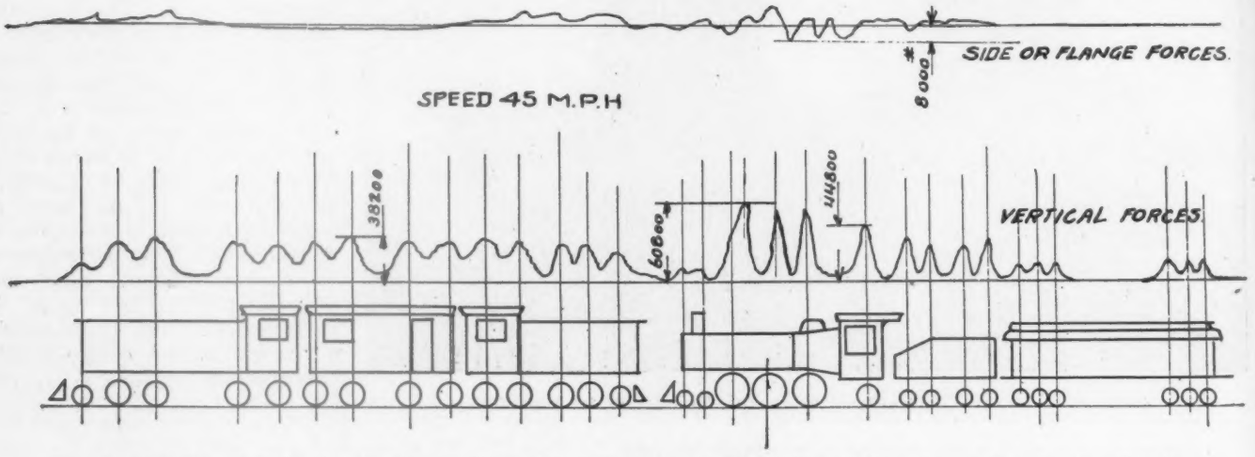
Tie to Determine Wheel Impact on Rail

AN interesting device, known as an otheograph, which is in effect a test tie for measuring simultaneously the vertical and transverse thrust or impact of a wheel on a rail, has been recently developed by the General Electric Company, Schenectady, N. Y., and a number of these ties are being installed on the company's test tracks at Erie, Pa. The instrument shows by graphic records the effect of each separate wheel of a locomotive or car on each of the two rails.



A General View of the Otheograph Tie

These otheograph ties may be installed in place of the regular ties, either singly or several grouped together on curves or tangent track. Provision is made for the use of two different springs for recording the vertical load, one having a deflection of about ⅛ in. for each 25,000 lb. of axle loading, and the other spring having the same deflection for each 50,000 lb. of axle loading. The springs are designed for a maximum deflection of ⅜ in. The springs for recording the transverse thrust have a deflection of about ⅛ in. for each 20,000 lb. The deflection of the spring is recorded through a lever having a ratio of 8 to 1, the record being traced on paper wrapped around a revolving cylinder similar to an engine indicator. The operating mechanism provides for moving the recording cylinder on any number of ties simultaneously so that as many records may be taken of each wheel on each side of the locomotives as there are ties that are grouped together.



Experimental Record Made of a Test on C. M. & St. P. Electric and Pacific Type Steam Locomotive Coupled Together. Figures Show Approximate Stresses in Pounds

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In the fall of 1922 there were 152 locomotives, 116 tenders, 242 passenger cars, 1,682 closed freight cars, 870 open freight cars and 3 cranes in use on the Greece State Railway system. Nine of these locomotives, however, were left in Asia Minor, and 20 per cent of the remainder and 30 per cent of the passenger cars were in bad order. The locomotives are small and of old design, except a few bought in the United States and some "armistice" engines turned over to Greece out of deliveries from Bulgaria and Germany. The cars are small and badly worn.

The poverty of the Greek state has prohibited any except emergency remedies, and replacements have been almost out of the question. Earnings in pre-war years have been replaced by deficits that have resulted from costly working of inefficient locomotives, from increased wages, from higher repair costs, and from expensive track maintenance.

GENERAL NEWS

A report from Valparaiso states that a project is to be submitted to congress for the expenditure of $80,000,000 on the construction of new railways in Chile.

The International-Great Northern has appealed to the United States Supreme Court in the suit involving its desire to move its shops from Palestine, Tex., to Houston.

The Freight Car Shops of the Texas & Pacific at Marshall, Tex., during the month of August, built 146 new cars and rebuilt 69. On one track, running repairs were made on 1,917 freight cars.

The Missouri Pacific has increased its average miles per car per day from 20.84 in April to 31.98 in August. During August the road also established another record by loading locally and receiving from connections 130,810 cars compared with a previous record of 125,347 cars in October, 1916.

The Pennsylvania Railroad offers $1,000 in prizes in an essay contest, open to all employees, on the subject of "The benefits of employee ownership of stock and securities of the Pennsylvania Railroad through the Employees' Provident and Loan Association." In each of the four operating regions, at Altoona Works, and in the general offices, three prizes are being offered for the best essays written by the employees. The first prize will be two shares of stock (par value $50 per share) in the Pennsylvania Railroad Company, the second prize one share of stock, and the third prize a credit on the books of the Provident and Loan Association amounting to half the cost of one share of stock.

Rumored That P. R. R. Will Buy Equipment

It is reported from several sources that the Pennsylvania is making plans for the purchase of a large number of locomotives and cars and also of a considerable tonnage of rail. This information has not as yet been officially confirmed.

Anthracite Shipments for September

Shipments of anthracite for the month of September, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 2,194,940 gross tons. Operation was resumed on September 19, and during the ten working days to the end of the month, there was a daily average shipment of 219,490 gross tons. This daily average could have been materially increased had the collieries resumed full operation on September 19. Some, because of an insufficient force of men, did not resume operation until a later date. The average daily shipment during the preceding month of August, was 247,105 tons.

Savannah Shops Receive Safety Banner

A banner has been awarded to the employees of the Savannah Shops of the Atlantic Coast Line in recognition of the safety record made in those shops during a period of three months in which there was only one personal injury that caused a loss of time of more than three days. The total number of employees in these shops is 554. Robert Scott, chairman of the General Safety Committee, gives credit for this excellent record to J. W. Reams, master mechanic, and his assistants, and to the members of the local safety committee. On the Atlantic Coast Line as a whole there are 28 safety committees on which serve 350 members.

Fires

The Gadsden Car Works, Gadsden, Ala., owned by Southern Railway interests, sustained a loss of about $300,000 by fire on October 11. The erecting shop, 200 ft. x 600 ft., was destroyed, together with other property, and 66 new freight cars. The main car shop was not damaged.

The car shops of the Pennsylvania Railroad at Camden, N. J., were damaged by fire on the night of October 15 to the extent of about $500,000. One of the four main buildings, 60 ft. x 300 ft., was destroyed and 12 coaches were badly damaged. By heroic efforts, the small force of men on duty saved 15 comparatively new coaches. Of the 1,800 men employed at these shops, about 400 worked in the section destroyed.

Pennsylvania Savings Fund to be Discontinued

Since the formation, in July of this year, of the Pennsylvania Railroad Employees' Provident and Loan Association, which has a saving fund provision, the need for the Pennsylvania Railroad Employees' Saving Fund, established by the company in 1888, has ceased to exist; and the Board of Directors of the road has issued an order stopping the receipt of deposits by the older fund after October 31, and discontinuing payment of interest on deposits on December 31, 1923. Depositors may transfer money to the Saving Fund of the new Employees' Provident and Loan Association.

The Pennsylvania Railroad Employees' Saving Fund has regularly paid an average of 4 per cent interest on deposits and has very successfully provided the facilities for which it was intended.

Wage Statistics for July

The monthly returns of Class I carriers to the Interstate Commerce Commission show that since January, 1923, there has been an increase from month to month in the total number of railroad employees. For the month of July, 1923, the summary shows a total of 1,954,687 employees, an increase of 20,758, or 1.1 per cent, as compared with the returns for June, 1923, and exceeds the employment reported for July, 1922, by 486,863, or 33.2 per cent. This abnormal increase resulted partly from the shopmen's strike, which became effective on July 1, 1922, and partly from the larger business of 1923. The total compensation reported for July, 1923, compared with that for June, 1923, shows an increase of $2,677,760, or 1 per cent, and in most cases the average monthly earnings show increases as compared with July, 1922.

Record Established in Locomotive Repairs

The El Paso shops of the Southern Pacific has established, what is claimed to be, a record in repairing locomotives. It turned out in 72 hours a Mikado type locomotive sent into the shops for Class 2 repairs. These repairs consisted of a new firebox, flues and general repairs to the machinery, including turning or renewing all of the tires. This sort of job ordinarily requires 40 days to complete. The locomotive was 11 days in the shop, of which two were Sundays when no work was performed, making a total of 9 eight-hour working days, or 72 working hours. Nearly every man in the shop had a part in establishing this record. In addition to breaking speed records for work of this type, the project put the facilities of the new erecting shop to a test that proved satisfactory.

The Monthly Report on Equipment Inspection

The monthly report to the President on the condition of railroad equipment just sent in by the Interstate Commerce Commission shows that in September 5,262 locomotives were inspected by the Bureau of Locomotive Inspection, of which 47.6 per cent were found defective, and 422 were ordered out of service. The percentage found defective is less than has been shown for any month since the shop strike was begun in July, 1922. During the same month 94,517 freight cars were inspected, of which 4½ per cent were found defective and 1 917 passenger cars, of which 2.3 per cent were found defective. During the month two cases involving 72 violations of the safety appliance act were transmitted to various United States attorneys for prosecution.

New York Central Shopmen Vote to End Piecework

By a vote of 10,000 to 4,000, shopmen employed by the New York Central have decided in favor of the abolition of piecework. There are 19,000 shopmen in the employ of the road and 14,000 voted. The Railroad Labor Board will be called upon to pass on the action of the shopmen. The case is a continuation of the one decided by the Railroad Labor Board last March, at which time the New York Central was ordered to operate its shops on an hourly basis. The ruling was protested by the New York Central authorities. Subsequently the Labor Board amended its decision, postponing the date upon which the road was ordered to install work on an hourly basis, and the case was remanded pending new negotiations.

Pennsylvania Shop Craft Elections

A final report of the elections held this year in the four operating regions and the Altoona Works shows that 85.9 per cent of all the shopmen on the entire Pennsylvania system voted, by secret ballot, for representatives on the various shop craft committees. The management believes that the result removes any reasonable doubt that might have existed as to the real desires of the Pennsylvania shopmen to be represented by employes elected by themselves. On the Southwestern Region 92 per cent of the shopmen participated in the balloting.

The complete returns show that 60,845 shop employees were eligible to vote for employee representatives in this branch of the service. The total number of ballots cast for employee representatives was 52,278. Out of the total number of votes cast, only 2,601, or less than 5 per cent, were declared to be invalid by the election tellers, jointly appointed by the men and the management.

Extent of Earthquake Damage to Japanese Railways

The New York office of the Japanese Government Railways received the following information by cable concerning the extent of the damage done by the earthquake to its railway lines.

The head office, the government railway hospital in Tokio, the government uniform manufacturing shops in Tokio, the government lumber creosoting plant in Tokio and the following stations were all destroyed: Shimbashi, Manseibashi, Iidamachi, Ueno, Ryogoku (all in Tokio), and Sakuragichi (in Yokohama, the terminal of the electric line between Tokio and Yokohama).

The Tokaido Line, east of Hakone and around Tokio was seriously damaged. Officials and employees' residences at Shiodome, near Shimbashi, Ueno and Ryogoku were entirely burned down, but no casualties resulted among the chief officials.

The losses also include the burning of 416 passenger cars, 31 electric cars, 893 freight cars, and 33 locomotive engines.

Law as to Handholds on Car Roofs Held Applicable to Tenders

The Georgia Court of Appeals holds that the provision of section 2 of the Federal Safety Appliance Act requiring that "all cars having ladders shall also be equipped with secure handholds or grabirons on their roofs at the tops of such ladders," in view of the rule of the Interstate Commerce Commission, conceded to apply to tenders, that: "A suitable metal end or side ladder shall be applied to all tanks more than 48 in. in height, measured from the top of end sill, and securely fastened with bolts or rivets," and the undisputed evidence that a tender (with its locomotive) is within the class of "cars having ladders," and in view also of the general intent and purpose of the act, was properly held applicable to the tender, notwithstanding that a tender, in a strict and literal sense, may have no roof.—Davis v. Maury (Ga. App.) 117 S. E. 283.

C. N. R. Neebing Terminal in Service

The Canadian National's new terminal at Neebing, near West Fort William, Ont., has been placed in service. The terminal was built to expedite the handling of grain traffic, most of which goes via lake from this point eastward.

The Neebing yard is designed to handle 2,000 cars a day classifying them for distribution to the elevators and vessels. Most of the cars will be put over the hump. There are eight receiving tracks with a capacity of 80 cars each; an eastbound classification yard with 20 tracks of a total capacity of 1,250 cars; a westbound departure yard of 13 tracks, each with a capacity of 80 cars, and repair tracks with a capacity of 108 cars.

The buildings and equipment include a 24-stall roundhouse; an 85-ft. electrically operated turntable; a 300-ton coaling station; a 150,000-gal. steel water tank; a 1,000-gal. oil tank; an automatic electrically driven ash remover and loader, as well as other modern mechanical features in and about the repair yards, engine houses and plant.

Locomotive Shipments in September

The Department of Commerce has given out its September figures on shipments of locomotives from the principal manufacturing plants, based on reports received from the individual establishments, as follows:

	September, 1923	August, 1923	September, 1922	Nine months' total January to September 1923	Nine months' total January to September 1922
Shipments—					
Domestic	313	259	113	2,115	585
Foreign	22	13	6	136	175
Total	335	272	119	2,251	760
Unfilled orders (end of month)—					
Domestic	1,102	1,406	1,347	....	....
Foreign	76	91	116	....	....
Total:	1,178	1,497	1,463	....	....

Motor Trains Increasing in France

The use of internal-combustion motors for trains appears to be developing rapidly in France. The state lines, it is announced, have recently placed an order for 10 units on the model of the one tried out successfully between Mortagne and St. Gauberge, the engine being built into an ordinary passenger coach. The Renault firm is also actively engaged in perfecting a new type of motor train called the Scemia-Renault, which was run on trial recently over the lines of a local Rheims company. This car carries 40 passengers and is equipped with double-end controls whereby the necessity of a turntable is avoided. On the 350-mile stretch between Rheims and Asfled, with 2.5 to 2.8 per cent grade, the average gasoline consumption was 108 gallons per 1,000 miles and the average speed 25 miles per hour. With a trailer, the consumption would be 138 gallons. It is stated that orders for six cars have been received and that the Societe des Transports en Commun de la Region Parisienne, which controls all the surface traffic in and around Paris, intends to place one of them in regular service on the Versailles-Les Mureaux line.

Recent Labor Board Decisions

A number of decisions of local character have marked the return to activity of the Railroad Labor Board after the summer vacation. Clerical employees on the Southern Pacific holding positions of minor or supervisory authority below the rank of subordinate officials have been granted all of the privileges accruing to the ordinary workers, including the eight-hour day, benefits of the rule relating to discipline, seniority, overtime and various other provisions. The board denied a petition for rehearing by the Gulf Coast Lines and the Houston Belt & Terminal on a decision handed down June 29, directing that a secret ballot be taken to determine whether the Railway Employees' department of the American Federation of Labor or a "company" organization should represent the shop employees on the two lines.

Shopcrafts employees on the Michigan Central and the Ann Arbor have been granted wage increases of two cents an hour, according to notices recently sent to the Labor Board.

A railway employee's membership or non-membership in a labor organization is not a matter of compulsion, according to a decision of the Labor Board in sustaining the complaint of the Switchmen's Union of North America against a contract of the San Antonio & Aransas Pass and the Brotherhood of Railroad Trainmen guaranteeing that 85 per cent of the road's yard employees should be members of the trainmen's organization. In the board's decision it was noted that the Switchmen's Union of North America "negotiated the first percentage agreement ever executed, but that organization has renounced the practice and become a victim of it." Reinstatement of an employee who had been discharged through

operation of the percentage provision was ordered by the board. In another decision, the Labor Board held that it was without jurisdiction to pass upon the question of the removal of the shops of the Missouri-Kansas-Texas from Sedalia, Mo., to New Franklin.

The Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen presented requests for wage increases of 12½ per cent to roads in all parts of the country on October 1. The petitions were filed with the roads whose contracts expired on that date and others will be filed when later contracts expire. The requests are for restoration of the scales in effect before the reduction of July 1, 1921.

National Exposition of Power and Mechanical Engineering

The second exposition of Power and Mechanical Engineering is is to be held in the Grand Central Palace, New York, from Monday to Saturday, December 3 to 8 inclusive. This exposition is being held at the same time that the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers are meeting in New York. In addition, the National Association of Stationary Engineers and affiliated bodies are organizing to interest their memberships in the exposition.

The exhibits will be supplemented by an extensive program of moving picture films to be presented in co-operation with the manufacturers. About 200 exhibitors have signed contracts for space at the exposition. The devices and apparatus to be exhibited are aimed to cover the field of power and mechanical engineering and the many special subjects devoted to this field of engineering work. One section of the exhibits will be devoted entirely to meters and other instruments for power plant control. The managers of the exposition are Fred W. Payne and Charles F. Roth, with offices in the Grand Central Palace.

Gas Manufacturers to Co-operate with Welding Schools

The Gas Products Association, Chicago, recently appointed an educational committee to co-operate with trade and technical schools all over the country in supplying a practical and standard course in welding procedure. The application of the welding processes has been extended to so many new fields that the demand for skilled operators is constantly increasing. It is felt that the welding school instructors are desirous of giving the students such training as will guarantee them the very best earning power. By making a thorough investigation of the needs of the industry and then making recommendations to the instructors, the course of study can be revised and standardized so as to more fully meet the requirements of the employers. The plan has already been submitted to some schools and has met with their co-operation.

The committee will endeavor to build up a list of accredited schools which are known to give standard instruction and whose students can be depended on to qualify as satisfactory welding operators. It is proposed to make this educational movement effective all over the country, as the members of the association have gas and apparatus manufacturing plants in practically all of the important industrial centers of the United States.

MEETINGS AND CONVENTIONS

Annual Meeting American Society of Mechanical Engineers

The forty-fourth annual meeting of the A. S. M. E. will be held in New York, December 3 to 6. The opening day of the meeting will be devoted to the meetings of the council and the administrative committees. The technical sessions will start on Tuesday. The Power Division will have a session on boiler plant economies. The Railroad Division is centering on the subject of modern subway cars and their operation. The Fuels Division and the Materials Handling Division are co-operating in one session on the subject of coal storage. The Machine Shop Practice Division will consider the development of modern metal stamping practice and will hear a progress report of the Research Committee on the present status of the art of cutting metals. The Management Division has a program on the relation of mechanical engineering to management in the metal working and other industries. In addition to the technical sessions, there will be a public hearing on the Power Test Codes for Stationary Steam Generating Units and the Test Code for Locomotives.

New York Railroad Club Will Hold Annual Dinner on December 6

The New York Railroad Club will hold its fifth annual dinner at the Hotel Commodore, New York, at 6:15 p. m. on December 6. Reservations may be made until November 24 by application to H. M. Norris, secretary to the president, Interborough Rapid Transit Company, 165 Broadway, New York; subscription price, $5 a person.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL. V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—W. C. Stephenson, Atlantic Coast Line, Rocky Mount, N. C.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual convention November 6-9, Hotel La Salle, Chicago. Exhibit by Railway Electrical Supply Manufacturers' Association.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting November 8. Paper on "Jewels of Industry" will be presented by Francis Bowman, advertising manager Carborundum Company, Niagara Falls, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting November 13, annual dinner and election of officers.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 6000 Michigan Ave., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting November 13, Copley-Plaza Hotel, Boston. Paper on "A Railway Contribution to the Development of a Nation" will be presented by D. C. Coleman, president, Canadian Pacific.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York. Annual dinner December 6, Hotel Commodore, New York, N. Y.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting November 9. A paper on "Europe—Five Years After the Armistice" will be presented by Dean Scarlett.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The American Steel & Wire Company has purchased 130 acres of land at Gary, Ind., on which it will construct a new plant.

The McMyler Interstate Company, Cleveland, Ohio, has removed its New York City office from 50 Church street to the Woolworth building, 233 Broadway.

A. W. Gillespie & Co., 426 South Clinton street, Chicago, has changed its name to the Ar-an-ess Manufacturing Company, and will continue the business at the same location as heretofore.

The property of the Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio, has been sold at public auction to R. Huntington, of the Huntington National Bank, Columbus, Ohio.

The Blacker Engineering Company, Inc., New York, manufacturers of blacksmithing hammers, has opened an office in Pittsburgh at 421 Wood street, with George Hesse as district manager.

John Knox Nimock has been appointed assistant purchasing agent of the American Car & Foundry Company, New York. Mr. Nimock was born in Ireland and came to the United States in 1894. He received his education in the Southern Illinois Normal University at Carbondale, Ill., in return for which he taught in the public schools of the state. After taking up a business course he entered the service of the American Car & Foundry Company at St. Louis, Mo., in 1904, and was transferred to New York in 1918. Mr. Nimock started work with the American Car & Foundry Company as a stenographer and has been steadily advanced until he now becomes assistant purchasing agent, with headquarters at New York City.

J. K. Nimock

Milton C. Fidgeon, who has served for a number of years with Joseph T. Ryerson & Son, Inc., Chicago, has been appointed eastern machinery sales manager, with office at 30 Church street, New York City.

The American Brake Shoe & Foundry Company will construct a new plant at North Kansas City, Mo., and is now accepting bids on a foundry, sand and cleaning shop and machine and repair shop, at an estimated cost of $300,000.

H. A. Wilson has been appointed manager of the Detroit branch of the Gibb Instrument Company, Bay City, Mich., succeeding F. M. Luchs, resigned. Mr. Wilson was formerly district manager in New York for A. P. Munning & Co.

Albert S. Boisfontaine, assistant to the manager of the Southern Pine Association, New Orleans, La., since last June, has been appointed assistant secretary. Mr. Boisfontaine has been serving in a number of capacities with the association since 1917.

P. E. Stickler, formerly locomotive engineman on the Southern Pacific and L. H. Rupert, formerly locomotive engineman on the Mexico North Western, have been appointed service engineers of the Franklin Railway Supply Company, Inc., New York.

The Linde Air Products Company, New York, recently started continuous operations in its new oxygen producing plant, Savannah, Ga. S. P. Wilson, Jr., is operating superintendent. An additional warehouse has also been opened at Charlotte, N. C.

Blake D. Hay has been appointed district manager of the Williams Tool Corporation with headquarters at Chicago. Mr. Hay, formerly located at Erie, Pa., will take charge of the Chicago branch office and territory, succeeding H. E. L. Mey, resigned.

B. B. Milner, recently from the Orient, will delay his return on account of the earthquake in Japan, and has arranged for an office in room 1237, Knickerbocker building, New York City. Mr. Milner has been serving the Japanese Government railways and certain railroad supply sources in this country, with his headquarters at Tokio, Japan.

John Baker has been appointed assistant vice-president of the Locomotive Fire Box Company, manufacturers of Nicholson thermic syphons. Mr. Baker entered railway service with the Lake Shore & Michigan Southern which is now a part of the New York Central, as clerk and stenographer for the assistant trainmaster. In May, 1903, he entered the employ of the Chicago, Rock Island & Pacific, since which he has been successively stenographer for the roadmaster and the superintendent, secretary to the general superintendent of motive power, chief clerk to the master mechanic and superintendent of motive power and chief clerk to the general superintendent of motive power. He held the latter position for the last four years, and resigned to become associated with the Locomotive Fire Box Company on October 1.

John Baker

John B. Wright, assistant district manager of the Westinghouse Air Brake Company, Wilmerding, Pa., has been appointed assistant to vice-president with headquarters at the general offices in Wilmerding, Pa. He will also retain the title of assistant district manager in charge of the company's commercial activities in the Pittsburgh district which he has held since January, 1920. Mr. Wright was born on July 27, 1875, at Pleasantville, Pa., and was educated in the public schools of his native town and at Central State Normal School, Lock Haven, Pa., graduating in 1896. He worked for about 18 months with the Cambria Steel Company at Johnstown, Pa. In February, 1899, he entered the service of the Westinghouse Air Brake Company at Wilmerding, as a clerk in the engineering department. After serving for some time as chief clerk in that department he was transferred to the general office in charge of engineering correspondence and subsequently was made assistant to the vice-president. In May, 1919, he was appointed assistant southeastern manager and in January, 1920, was made assistant district manager.

J. B. Wright

The main office in Tokio, Japan, of Roku-Roku Shoten having been destroyed, requests are made to manufacturers in the United States to send to the company's branch office at Osaka, street address Enokojima Nishiku, complete catalogs and prices to replace their files. S. Noda is president of the company.

R. A. Hamaker, manager of the Montreal branch of the Canadian Johns-Manville Company, Ltd., was swept off from his boat and drowned, in Lake St. Louis recently. Mr. Hamaker

was born in October, 1882, at Reading, Pa. In 1907 he became identified with the Johns-Manville Company, and in 1909 went to Montreal to take charge of the company's interests in that city.

R. R. Lally, formerly of Baltimore, Md., has been appointed manager of sales of the Globe Steel Tubes Company, Chicago, in charge of eastern territory with headquarters at 110 East Forty-second street, New York City, and A. A. Loeffler has been appointed manager of sales in charge of Michigan territory with headquarters at 5-169 General Motors building, Detroit, Mich.

The Clark Car Company, of Pittsburgh, Pa., has appointed B. K. Mould, eastern manager with headquarters at 2107 Woolworth building, New York City. Mr. Mould formerly spent thirteen years with the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa., and later several years as eastern sales manager, condenser department of the Elliott Company, Jeannette, Pa.

D. S. Murphy has been appointed chief service engineer of the Franklin Railway Supply Company, Inc., New York. Mr. Murphy was born at Visalia, Cal., and attended schools in that state and in Missouri. He began his railroad career in 1903 with the Missouri Pacific in yard and station service. He was connected with the transportation department of that road until 1906, when he joined the operating department of the Missouri, Kansas & Texas at St. Louis. From 1913 to 1917 he was office assistant to president of the M. K. & T. and then to 1918 he served in a similar capacity with the federal manager (United States Railroad Administration) of the group comprising the St. Louis & San Francisco, Missouri, Kansas & Texas and several smaller lines. On March 1, 1918, he was appointed trainmaster of the St. Louis division, Missouri, Kansas & Texas and the following May trainmaster of the Osage division. In September, 1918, he was promoted to superintendent of the Oklahoma district, with headquarters at Oklahoma City, Okla. On March 1, 1920, he was made superintendent of the McAlester district, with office at Muskogee, leaving that position to become chief service engineer of the Franklin Railway Supply Company, Inc., as above noted.

D. S. Murphy

Joseph Wainwright has been appointed sales manager and W. C. Chapman, district manager of the Philadelphia (Pa.) district for Manning, Maxwell & Moore, Inc., New York. Messrs. Wainright and Chapman will have headquarters in the Pennsylvania building, Fifteenth and Chestnut streets. Walter V. Lawton has been appointed district manager of the Boston (Mass.) district, with headquarters in the Textile building, 99 Chauncy street.

The Selflock Nut & Bolt Co., Inc., East Syracuse, N. Y., manufacturers of friction fit nuts and bolts, have entered into a contract with the Bethlehem Steel Company, Bethlehem, Pa., operative at once, for the manufacture and sale of carriage and machine bolts, track bolts and heavy railway nuts and bolts. The Selflock Company will increase its own facilities and specialize on S. A. E. Selflock products, as well as cap screws with Selflock threads.

Loyall A. Osborne, president of the Westinghouse Electric International Company, New York, has started on a trip to Japan to confer with prominent industrialists in Tokio. He sailed from San Francisco on October 10. Mr. Osborne is vice-chairman of the National Industrial Conference Board, and a member of the Imperial Order of the Rising Sun of Japan. Mr. Osborne is accompanied to Japan by Gen. Guy E. Tripp, chairman of the Westinghouse Electric & Manufacturing Company.

The Thornburgh Universal Gasket Manufacturing Corporation, Cicero, Ill., has been organized and has taken over the assets of the Universal Gasket & Manufacturing Company, Cicero, Ill. W. N. Thornburgh, president and treasurer of the W. N. Thornburgh Manufacturing Company, is also president and treasurer of the new company. J. J. Meydrech, vice-president and secretary of the W. N. Thornburgh Manufacturing Company, is also vice-president and secretary of the new company. George E. Barton is vice-president and sales manager.

Frederick V. Green, has been appointed assistant to the president of the Pittsburgh Testing Laboratory with headquarters at 50 Church street, New York. Mr. Green was born in New York City and received his education at Nyack, N. Y. After some experience in the lumber business with his father, he organized in 1895 the Empire Engine & Motor Company and was its treasurer until he joined the Westinghouse Air Brake Company in 1902. He was assistant general sales manager in the New York territory for the Westinghouse Air Brake Company until 1919, when he was appointed manager at Johannesburg, South Africa, for the Baldwin Locomotive Works, returning to this country to enter the service of the Pittsburgh Testing Laboratory.

C. H. Larimer, mechanical expert of the Westinghouse Air Brake Company in the New England territory, has been appointed consulting mechanical expert. He is succeeded as mechanical expert by R. P. Ives, a locomotive engineman from the New York, New Haven & Hartford. H. J. Robinson, for many years mechanical expert of the Westinghouse Air Brake Company at Seattle, Wash., has been appointed superintendent of special training to supervise the special apprenticeship courses for college students at the company's Wilmerding plant. The Westinghouse Company has opened a new branch office at Houston, Tex., in charge of mechanical expert John Hume, assisted by C. A. Breit, who has been transferred from the company's office at St. Louis.

Joseph Hyde Ames, chief engineer, American Car & Foundry Company, died suddenly at Chicago on October 11, and was buried at Lee, Mass. He was born at Brimfield, Mass., on March 22, 1865, and his early education was received at Kings School, Stamford, Conn. He started his professional career with the Northern Pacific at St. Paul, and in 1885, he went to the Peninsular Car Company, Detroit, as draftsman and estimator, later being made assistant superintendent. When the Michigan-Peninsular Company was formed in 1892, he was put in charge of the engineering work, and later was made assistant general manager. Upon the formation of the American Car & Foundry Company in 1899, he was given the title of mechanical superintendent of the two Detroit plants. In 1905, he was promoted to chief engineer, in charge of improvements to plants and machinery, being located at St. Louis for some years and later at Chicago. During the war activities from 1916 to 1919, he was in charge of all engineering work on war contracts at the Detroit plant. Since 1919, his headquarters have been in New York City. Mr. Ames was widely known as an engineer and was considered an authority on car design and manufacturing equipment.

J. H. Ames

Charles M. Brown has been elected president of the Colonial Steel Company, Pittsburgh, Pa., and J. Trautman, assistant sales manager, has been appointed sales manager to succeed Mr. Brown. Mr. Brown was born on October 16, 1870, at Pittsburgh. He graduated from Yale University in 1891, with the degree of A. B., and from the following August served with Howe, Brown & Co., Ltd., Pittsburgh, until that firm was absorbed by the Crucible Steel Company of America. Mr. Brown served for one year in the sales department of the latter company. In 1901, when the Colonial Steel Company was formed he became secretary and general sales manager. About 1917, he was made vice-president in charge of sales and now becomes president of the same company, as above noted.

TRADE PUBLICATIONS

INSULATING MATERIALS.—A 160-page handbook entitled, "Everything in Insulation," has been issued by the Mitchell-Rand Company, New York.

HYDRAULIC RIVETERS.—A four-page circular illustrating and describing Hanna hydraulic riveters has just been issued by the Hanna Engineering Company, Chicago.

OIL BURNERS.—The Hauck Manufacturing Company, Brooklyn, N. Y., has just issued Bulletin No. 506 illustrating and describing its Venturi low pressure fuel oil burner, which operates with air pressure from 8 oz. to 2 lb.

PORTABLE ELECTRIC TOOLS.—A 32-page miniature catalogue No. 3027, briefly describing the complete line of Hisey portable electric tools for all purposes, has been issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

GRINDING MACHINES.—A 16-page, illustrated bulletin, No. 1305 superseding No. 1304, fully describing the construction and advantages of Hisey ball bearing grinding machines, has been issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

COAL.—A booklet dedicated to the men in boiler rooms, laboratories and offices, who are untiringly seeking ways of conserving resources through the more efficient burning of coal, has been issued by the Stoker Manufacturers' Association, Philadelphia, Pa.

POWER PAINTING.—Air brushes, air compressors, pneumatic painting machinery, finishing room equipment and other devices for the mechanical application of paint are described in Circular No. 20 recently issued by the Paasche Air Brush Company, Chicago.

WHITING HOISTS.—A six-page folder entitled, "Give Your Locomotive Repair Shops This Powerful Lift," has been issued by the Whiting Corporation, Harvey, Ill., featuring some of the uses to which its hoisting equipment can be put in railroad shops and material yards.

THE MICROGAGE.—Publication G, supplementing descriptive catalogue D in showing the improved construction of the microgage, which combines the functions of the hand micrometer and the limit snap gage, has recently been issued by the Microgage Company, Boston, Mass.

CORE OVEN EQUIPMENT.—Core ovens, core oven racks, core oven cars and trucks, etc., are described in catalogue No. 170 recently issued by the Whiting Corporation, Harvey, Ill. This catalogue supersedes No. 163 and contains a number of illustrations of typical installations of Whiting core equipment.

BELTING TABLES.—Tables showing the brands of Schieren belting best suited to the different kinds of mechanical equipment under various operating conditions are given in the fifteenth and sixteenth installments of "Practical Facts About Belting," reprints of which may be obtained from the Chas. A. Schieren Company, New York.

AIR HOISTS AND ELEVATORS.—Valves for cast iron and brass cylinder hoists and trolleys are among the equipment illustrated in Catalogue No. 169 recently issued by the Whiting Corporation, Harvey, Ill., outlining the general design and construction of its several types of air hoists and elevators. This catalogue supersedes No. 149.

HYDRAULIC MACHINERY AND POWER TOOLS.—"An Album of Engineering Achievement" is the title of a 64-page, illustrated catalogue recently issued by the Southwark Foundry & Machine Company, Philadelphia, Pa., featuring the wide application of Southwark hydraulic valves, accumulators, presses, intensifiers, power punches, etc.

ELECTRIC HEADLIGHTS.—A 12-page booklet entitled "Electric Headlights" has recently been issued by the Sunbeam Electric Manufacturing Company, Evansville, Ind., which illustrates and describes the locomotive headlight, industrial headlight, and floodlights manufactured by that company. The booklet also describes the focusing device used in conjunction with the air-tight, silver-plated, metal reflectors.

ELECTRIC MOTORS.—The Reliance Electric & Engineering Company, Cleveland, Ohio, has issued a 32-page booklet on its Type T heavy duty Reliance direct current motors. The booklet includes a detailed, illustrated description of how the motors are built, tables of ratings, general outline dimensions and a large number of illustrations showing motor applications.

DRILLING MACHINES.—Portable drilling and tapping machines, applicable to practically every branch and phase of engineering, are illustrated and described in catalogue No. 24 recently issued by William Asquith, Ltd., Halifax, England. The catalogue contains 43 neatly arranged pages, also a table showing the range of sizes in which this type of machine is built.

WELDING AND CUTTING EQUIPMENT.—Catalogue No. 23, covering its complete line of oxy-acetylene welding and cutting apparatus, lead welding, soldering, brazing and decarbonizing units, gas pressure regulators, automatic machines, generators and supplies, and containing cross-sectional views of equipment with detailed explanation, has recently been issued by the Torchweld Equipment Company, Chicago.

WROUGHT IRON PIPE.—A catalogue, outlining the differences between genuine wrought iron and steel pipe and summarizing the conditions of vent pipes in installations from 10 to 20 years old and over, has been issued by the A. M. Beyers Company, Pittsburgh, Pa. The catalogue also contains a report by an Investigating Committee of Architects and Engineers on wrought iron pipe as manufactured by the Beyers Company.

GRINDING MACHINES.—A 24-page booklet, Bulletin No. 520, primarily intended for the man or men who are interested in and responsible for dependable, low-cost and unfailing locomotive performance, has been issued by the Heald Machine Company, Worcester, Mass. The booklet, which is entitled, "Saving Minutes on the Road—Hours in the Shop," illustrates and describes typical railroad jobs done on the Heald grinding machine.

ANTI-FRICTION BEARINGS.—A paper entitled, "Anti-Friction Bearings in the Steel Mill," and the discussion which followed its presentation before the Association of Iron and Steel Electrical Engineers, is being distributed in the form of a 51-page illustrated booklet by the Reliance Electric & Engineering Company, Cleveland, Ohio. While the paper was prepared by A. M. MacCutcheon, chief engineer of the Reliance Company, it is written from such a standpoint that it is of general interest and value to users and designers of machinery and power equipment in other industries.

PULVERIZED FUEL SYSTEM.—"Lopulco Pulverized Fuel Systems" is the title of a catalogue issued by the Combustion Engineering Company, New York. This is the first publication the company has issued describing both the theory and mechanical features of its powdered coal system, which has recently been installed in connection with some of the most notable boiler plant projects in the country. The catalogue contains numerous illustrations, including a section through a Lopulco equipped boiler plant, which shows all the different elements of the system as well as interesting test data and information concerning some outstanding installations.

BOILER FEED PUMP AND FEED WATER HEATER.—The construction and operation of the Worthington locomotive boiler feed pump and feed water heater are clearly shown in colored diagrams in an attractive 16-page bulletin, B-1607-B, recently issued by the Worthington Pump & Machinery Company, New York. The heat and coal saving characteristics of the feed water heater are shown in curves. A table of the properties of steam is also given and examples illustrating its use in calculating the reduction in the amount of heat required to generate the steam, the amount of steam required for heating and the amount of water saved by the Worthington locomotive feed water heater.

CHARCOAL IRON BOILER TUBES.—A 52-page brochure, citing a few instances of the high resistance of Parkesburg charcoal iron boiler tubes to corrosion and long service life, has been issued by the Parkesburg Iron Company, Parkesburg, Pa. Following a brief outline of the physical properties of charcoal iron and its corrosion resisting qualities, is an interesting illustrated story of the Parkesburg process of manufacturing boiler tubes from the charging of the forge fire to the final inspection and test of the finished product. Attention is also called to "Recommended

Practice for the Application and Maintenance of Charcoal Iron Boiler Tubes, Arch Tubes and Superheater Flues," by G. H. Woodrooffe and C. E. Lester, which is now available in book form.

COMMERCIAL OXYGEN.—An attractively prepared bulletin describing the plant and process used in producing oxygen from the air by the Oxeco liquefaction method has recently been issued by M. Keith Dunham, Chicago. This bulletin contains thirty-four 5-in. by 11-in. pages. Numerous illustrations of the equipment are included; also a large scale colored insert giving a sectional view of the entire plant for producing oxygen from the air. The production process is described in detail with emphasis on the function of various parts of the equipment including the caustic solution mixing tank, caustic solution pump, air purifying towers, four-stage air compressor, oil purging plant, drying battery, high pressure filter, thawing coil, liquefaction column, gas meter, gas holder, oxygen gas compressor and cylinder charging ramp.

LUBRICATION.—A comprehensive, non-technical discussion of lubrication is afforded in a small 52-page booklet recently issued by the Dearborn Chemical Company, Chicago. This booklet will be of considerable assistance to the purchaser of lubricating oils and greases in deciding which grades will be most effective in developing maximum power equipment efficiency. The fact is emphasized that first cost should not be the only consideration in choosing lubricating oils and greases. Good quality is vital in order that the quantities used may be reduced to a minimum and also the losses due to friction. An interesting discussion of wet and dry steam cylinder lubrication is given. There are also chapters on steam turbine—unaflow engine—and air compressor lubrication. The closing chapter contains valuable information regarding laboratory control and methods of testing lubricants.

PYLE-O-LYTE is the name given to the latest bulletin issued by the Pyle National Company, Chicago. The bulletin, as catalogue No. 4, contains 28 pages, illustrating and describing the applications of Pyle National equipment to the various phases of railroad and construction lighting. There are many photographs and diagrams showing the different types of lighting units, together with the specifications for each. Lamps and reflectors are shown giving descriptive and dimensional tables. A portion of the bulletin is devoted to the explanation of floodlighting calculations which is clearly set forth by diagrams and sample calculations fully worked out. The different types of Pyle National turbo generators are illustrated ranging in capacity from 500 watts to 7½ kw. and steam turbines for various purposes ranging in speed from 2,000 to 5,000 r. p. m. and from ½ hp. to 12½ hp. are also shown.

WATERPROOFING.—The General Fireproofing Company, Youngstown, Ohio, has issued the sixth edition of a handbook on waterproofing. The booklet, which is a 72-page assembly, is illustrated by photographs of recent construction projects upon which the G. F. waterproofings and preservatives are used and, for the convenience of the reader, is divided into four sections as follows: Section 1—Substructural Waterproofing, devoted to the methods and materials for the waterproofing of foundations, basements, pits, tanks, pools, containers, and other structures subjected to hydrostatic pressure or dampness; Section 2—Superstructural Waterproofing, devoted to methods and materials for rendering walls and roofs proof against weathering and dampness, for the stainproofing of cut stone, for the preservation and beautifying of stucco, brick and concrete walls, and for filling expansion joints; Section 3—Cement and Wood Floor preservation, devoted to methods and materials for hardening, dustproofing, decorating and waterproofing cement and wood floors and for accelerating the setting and preventing the freezing of newly laid cement floors; and Section 4—Technical Paints and Coatings, devoted to the methods and materials for rendering walls, floors, and containers proof against acids and oils, for protecting structural steel and galvanized surfaces from rust and timbers from dry rot and decay, for bonding new concrete to walls, for waterproofing and hardening cut stone and cement blocks and for stainproofing limestone. Each section opens with a specification guide which tabulates various methods adapted to each problem and gives an index of the products useful in each case. This specification guide is then followed successively by a description of each method, followed in turn by a description of the various products for use under the particular method involved, and specifications as to their use. In all cases the specifications are illustrated with drawings to show how the work should be carried out.

EQUIPMENT AND SHOPS

Locomotive Orders

THE MISSOURI PACIFIC contemplates buying about 60 locomotives.

THE LOUISVILLE & NASHVILLE contemplates buying about 35 locomotives.

THE LONG ISLAND has ordered five switching locomotives from the American Locomotive Company.

THE ARGENTINE STATE RAILWAYS have placed an order for 1 4-8-2 type locomotive with the Baldwin Locomotive Works.

THE ALIQUIPPA & SOUTHERN has ordered one 0-8-0 type locomotive from the American Locomotive Company.

THE NADAWAH LUMBER COMPANY, Nadawah, Ala., has ordered 1, 2-6-0 type locomotive from the Baldwin Locomotive Works.

THE PENNSYLVANIA POWER & LIGHT COMPANY, Wilkes-Barre, Pa., has ordered 1, six-wheel switching locomotive from the Baldwin Locomotive Works.

THE LONG BELL LUMBER COMPANY, Longview, Wash., has ordered 2, 2-6-6-2 Mallet type locomotives and 1, 0-6-0 switching locomotive from the Baldwin Locomotive Works.

THE SOUTHERN PACIFIC has ordered 17, 2-10-2 type and 8, 4-6-2 type locomotives from the Baldwin Locomotive Works and has placed an order for 18, 4-8-2 type locomotives with the American Locomotive Company.

Passenger Car Orders

THE SOUTHERN PACIFIC contemplates buying about 125 new cars for passenger service.

THE NEW YORK, WESTCHESTER & BOSTON contemplates buying about 10 cars for passenger service.

THE CHESAPEAKE & OHIO has ordered 6 combination mail and express cars from the Pullman Company.

THE ST. LOUIS SOUTHWESTERN has ordered 5 steel underframes for baggage cars from the Commonwealth Steel Company.

THE LONG ISLAND has placed an order for 60 steel motor passenger cars for electric service with the American Car & Foundry Company.

THE PHILADELPHIA & READING has ordered 40 steel suburban coaches and 10 steel suburban combination coach and baggage cars from the Bethlehem Shipbuilding Corporation, Harlan plant.

Freight Car Orders

THE SOUTH AFRICAN RAILWAYS has ordered 400 steel grain cars from the Leeds Forge Company, England.

THE MEXICAN PETROLEUM COMPANY has placed an order for 100 tank cars of 10,000 gal. capacity with the American Car & Foundry Company.

THE CHICAGO & ALTON has placed an order for 250 gondola cars with the Pullman Company and an order for 350 gondola car bodies with the Ryan Car Company.

E. L. DOUGHERTY & Co. has ordered 100, 40-ton, 8,000 gal. capacity and 100, 50-ton, 10,000 gal. capacity tank cars, from the General American Tank Car Corporation.

THE UNION PACIFIC will have 25 caboose cars built at the shops in Albina, Ore. This company's program for new equipment, it is understood, calls for the purchase of several thousand cars.

THE NEW YORK, CHICAGO & ST. LOUIS has ordered 200 steel underframes from the American Car & Foundry Company, and has also ordered 10 underframes for caboose cars from the Pennsylvania Tank Car Company.

THE SOUTHERN PACIFIC has ordered 16 Kilbourne & Jacobs type automatic dump cars of 20 yd. capacity from the Case Crane

& Engineering Company. The company's program for new equipment, it is understood, calls for the purchase of about 18,000 cars.

Freight Car Repairs

THE MINNEAPOLIS & ST. LOUIS has ordered repairs to 600 box cars at the shops of the General American Car Company.

Machinery and Tools

THE SOUTHERN PACIFIC has placed an order for 2 axle lathes.

THE ERIE has placed orders for additional flue shop equipment with Joseph T. Ryerson & Son.

THE UNION PACIFIC has ordered a five-ton self-supporting jib crane from the Whiting Corporation.

THE MISSOURI PACIFIC has ordered one 200-ton locomotive hoist from the Whiting Corporation.

THE PENNSYLVANIA has placed an order for a 100-in. boring mill, also for two 42-in. boring mills and a heavy 42-in. by 16 ft. planer.

THE CHESAPEAKE & OHIO has placed an order with the Industrial Works, Bay City, Mich., for six 150-ton self-propelling steam wrecking cranes.

THE CHICAGO, BURLINGTON & QUINCY has ordered one 20-ton overhead electric traveling crane for its shops at West Burlington, Ia., from the Shaw Crane Company.

THE ILLINOIS CENTRAL is inquiring for one 1½ to 6-in. motor-driven tube cutting machine for use at Vicksburg, Miss., and one 54-in. heavy-duty motor-driven lathe for use at Waterloo, Iowa.

THE PHILADELPHIA & READING has awarded a contract to the Bury Compressor Company for two heavy duty duplex air compressors, with motors, exciters, starting panels, coolers, aftercoolers, and other apparatus for use in connection with the new terminal at Camden.

Shops and Terminals

GALVESTON, HARRISBURG & SAN ANTONIO.—This company will construct an addition to its roundhouse at San Antonio, Tex., to cost approximately $60,000.

CHICAGO, ROCK ISLAND & PACIFIC.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a 13-stall roundhouse at Shawnee, Okla.

ST. LOUIS-SAN FRANCISCO.—This company has awarded a contract for a one-story coaling station 26 ft. by 28 ft. at St. Louis, Mo., to the Howlett Construction Company, Moline, Ill.

ATCHISON, TOPEKA & SANTA FE.—This company has awarded a contract to Robert E. McKee, El Paso, Tex., for the construction of a new pipe and tin working shop at San Bernardino, Cal.

NEW YORK, CHICAGO & ST. LOUIS.—This company plans the construction of additions to its shops at Frankfort, Ind., including a new engine house, repair shop and related structures.

ATLANTIC COAST LINE.—This company has awarded a contract to Roberts & Schaefer Company, Chicago, for the construction of a 500-ton three-track automatic electric coaling station at Waycross, Ga.

UNION PACIFIC.—This company has awarded a contract to the Graver Corporation, East Chicago, Ind., for the erection of two 10,000 gal. per hour water softening plants at Fossil, Wyo., and Arden, Nev.

THE MISSOURI CAR COMPANY, East St. Louis, Mo., will erect a car equipment shop at Denver, Colo., at an approximate cost of $750,000. The plant will be a duplicate of the company's East St. Louis shop, will manufacture all kinds and types of steam and electric cars and will be known as the Colorado Railway Equipment Company.

ELGIN, JOLIET & EASTERN.—This company has awarded a contract to the Roberts & Schaefer Company, Chicago, for the installation of automatic electric elevating equipment in its coaling station at Rossville, Ill., and will construct a new car repair shop at Joliet, Ill., to replace the building recently destroyed by fire. The new structure will be 300 ft. by 500 ft., and will cost approximately $500,000.

PERSONAL MENTION

General

D. R. MCGRATH, division master mechanic of the Chicago, Burlington & Quincy, with headquarters at Brookfield, Mo., has been promoted to air brake instructor, with headquarters at Chicago, succeeding P. J. Murrin, retired on pension after 50 years of active service.

A. C. GRAHAM has been appointed foreman in charge of reclamation of the Chicago, Burlington & Quincy at Eola, Ill. Prior to entering the service of the C. B. & Q., Mr. Graham was employed at the reclamation plant of the Atchison, Topeka & Santa Fe at Corwith, Ill.

W. C. STONE, master car builder of the St. Louis-Southwestern with headquarters at Pine Bluff, Ark., has resigned to become mechanical superintendent of the American Refrigerator Transit Company with headquarters at St. Louis, Mo., succeeding T. E. Parker, resigned.

H. C. MANCHESTER, superintendent of motive power and equipment of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., has resigned, and C. J. Scudder, superintendent of the Scranton shops, has been appointed acting superintendent of motive power and equipment.

PATRICK J. COLLIGAN, master mechanic of the Chicago Terminal division of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been promoted to superintendent of motive power of the Second district, with headquarters at El Reno, Okla., succeeding W. J. O'Neill, whose appointment as general superintendent of motive power of the Denver & Rio Grande Western was reported in the October issue of the *Railway Mechanical Engineer*. Mr. Colligan was born on January 24, 1868, at Rock Island, Ill. He entered railway service in January, 1886, as a machinist apprentice on the Chicago, Rock Island & Pacific and served in this capacity until 1891, when he entered the employ of the Chicago, Milwaukee & St. Paul as a machinist at Savanna, Ill., where he remained until 1893, when he again entered the employ of the Rock Island as a machinist at Horton, Kan. From January, 1894, until 1898, he was machinist and gang foreman on the Missouri, Kansas & Texas at Dennison, Tex. In 1898 he returned to the Chicago, Rock Island & Pacific as a machinist at Davenport, Iowa, and in 1899 was promoted to roundhouse foreman at Chicago. In 1901 he was transferred as roundhouse foreman to Trenton, Mo., and later to Natick, Ill. In 1903 he entered the employ of the Illinois Central as general foreman and master mechanic at Clinton, Ill., but in 1904 returned to the Rock Island as a gang foreman at Silvis, Ill. In 1905 he was promoted to general foreman at Chickasha, Okla., and from 1906 to 1910, he was master mechanic, with headquarters at Fort Worth, Tex. From 1910 until 1914 he was master mechanic at Dallas, Tex. He served as master mechanic at Chicago from 1914 until his recent promotion.

Master Mechanics and Road Foremen

H. C. GUGLER, general foreman of the Chicago, Burlington & Quincy, at Wymore, Neb., has been promoted to master mechanic of the Wymore division with the same headquarters, succeeding G. O. Huckett, assigned to other duties.

C. B. DAILEY, master mechanic of the Cedar Rapids-Minnesota division of the Chicago, Rock Island & Pacific, with headquarters at Cedar Rapids, Iowa, has been transferred to Chicago, succeeding P. J. Colligan. T. W. McCarthy, master mechanic of the Kansas division, with headquarters at Horton, Kan., has been transferred to Cedar Rapids, Iowa, succeeding Mr. Dailey.

Purchasing and Stores

H. A. HUMES has been appointed district storekeeper of the Northern Pacific at Tacoma, Wash., succeeding R. W. Hoisington, resigned. W. H. Robinson has been appointed division storekeeper of the Idaho division at Parkwater, Wash., succeeding Mr. Humes, and R. G. Becker has been appointed division storekeeper of the Minnesota Division at Staples, Minn., succeeding Mr. Robinson.